BLUE JAY

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***Front cover**: Brown Thrasher, May 15, 2007 at Cosmopolitan Park, Saskatoon*
Nick Saunders

***Back cover**: Male Sharp-tailed Grouse charging each other in a community pasture near Pike Lake at 7 am on April 29, 2008.* *Nick Saunders*

***Inside front cover**:*
top: Figure 1. Cassin's Vireo from the side. Figure 2. Cassin's Vireo from the back. See article on page 73. *Philip.S. Taylor*

bottom: Barn Swallow building nest on cliff face on Bradley Lake, MB. Photograph taken on June 9, 2007. See article on page 78. *David Raitt*

***Inside back cover**:*
top: Figure 1. Adult Mormon Metalmark in Grasslands National Park on 19 August 2007. See article on page 105. *Juhachi Asai*

middle: Figure 2. Buckeye, ventral view, Oak Hammock Marsh, MB, 16 September 2007. See article on page 107. *Larry de March*

bottom: Figure 3. Buckeye, dorsal view, Patricia Beach, MB, 15 September 2007. See article on page 107. *Peter Taylor*

Freshly killed Least Weasel found in a Great Horned Owl's nest high in a Cottonwood in Gillanders' Coulee which drains into the Saltburn valley east of Lacadena. Photograph taken around 11:00 am on 4 May, 2008 by Dan Zazelenchuk

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EDITORS' MESSAGE

BLUE JAY AND NATURAL HISTORY

Blue Jay is a journal of natural history and conservation, but what is natural history?

If you cast about for the presence of 'natural history' in your world, you might think of museums that carry the name natural history – Saskatchewan Museum of Natural History (now Royal Saskatchewan Museum) or American Museum of Natural History in New York City. Or, you might think of classic works such as Gilbert White's *The Natural History of Selborne*, first published in the 1700s, or of famous naturalists such as Charles Darwin who studied a broad range of natural phenomena including earthworms, barnacles and orchid pollination. Museum collections, and what naturalists have done or written about, help define the field in our minds, but when it comes to deciding what falls under the rubric of natural history for a publication like *Blue Jay*, we need a clearer idea of what it includes and what it does not.

Dictionary definitions of natural history help delimit the field. Natural history is "the science or study dealing with all objects of nature" and "the aggregate of knowledge connected with such objects." Natural history is a branch of natural science, which is "the science or knowledge dealing with objects in nature as distinguished from mental or moral science, abstract mathematics, etc."[1]

If nature is defined as "the material world, especially as surrounding man and existing independently of his activities" and science as "the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment," natural history, as a science, can be summed up as the systematic study of our natural, physical surroundings through observation and experiment. As a body of knowledge, natural history encompasses what is known, and can be learned, about our natural surroundings.

Questions concerning the content of *Blue Jay* have arisen many times during the life of the publication.[2] Isabel Priestly, the founder and first editor of *Blue Jay*, strove for a balance between nature appreciation and scientific study of nature. As she wrote in the December 1945 issue of *Blue Jay*, page 1:

"We have always tried to present material in the *Blue Jay* in an informal manner, just as if two or three nature lovers had got together and were exchanging experiences. At the same time we have always tried to present facts which are scientifically correct."

Isabel Priestly's emphasis on scientific accuracy was not just due to her science background, (she had been studying botany in England before she came to Saskatchewan after the First World War), but because of immediate events: "What prompted Isabel Priestly's remarks on that occasion was the decision just taken to file all records sent to the *Blue Jay* for the use of the Provincial Museum, and her consequent concern that these records should be accurate. To ensure that the details of every observation

were carefully recorded, she made the homely recommendation that the observer should note his observations at once on a pad of paper in the kitchen or in an easily accessible notebook." (p.13)

Priestly's appreciation of the value of contributions by amateurs to the science of natural history is reiterated in Margaret Belcher's praise for the 1952 issue of *Blue Jay*, the 10 year anniversary issue compiled by the editor at the time, Lloyd Carmichael.

"The anniversary number was dedicated to the first editor, Mrs. Isabel Priestly. Its wealth of unpretentious, charmingly related observations constituted a genuine tribute to Mrs. Priestly and her dedication to bringing nature lovers in Saskatchewan together. But Isabel Priestly was not only a nature lover, she was also a naturalist and trained botanist. She would consider publishing the simplest note, but only if it were an authentic observation. For that reason, her *Blue Jay* made a contribution to the study of natural history that both scientists and laymen could appreciate. It recognized the value of the contribution that an amateur could make." (p. 25)

Blue Jay editors from Isabel Priestly's time to the present have striven to maintain the balance between informality and scientific rigor, readability and exactitude. This is because we believe in the value of observations that are objective and carefully recorded. Accuracy of observation is important for the systematic study of our natural surroundings; accuracy puts natural history in the realm of science, not just hearsay, guesswork and personal opinion.

Natural History is a low-tech discipline in which anyone so inclined can participate. Serious practitioners, however, who are aware of the scientific underpinnings of natural history, must take care not to make assumptions and not to let opinion or what is 'probable' be elevated to the status of fact. This is why strict standards are applied to evaluate observations, bird sightings for instance, before acceptance into the permanent record.

In this regard, it is useful to keep in mind the scientific approach of the character Galileo in Bertolt Brecht's play, *Galileo*, as quoted in Don Gayton's reminiscences of Stan Rowe in the September 2004 of *Blue Jay*:

"Perhaps they are clouds, perhaps they are sunspots, but before we assume they are sunspots, which would be most opportune for us, let us rather assume they are fishes' tails. Yes, we will question everything, and everything once again. And, we shall advance not in seven-league boots, but at a snail's pace. And what we find today we shall strike from the record tomorrow, and only write it again when we have once more discovered it. And what we wish to find, if we find it, we shall regard with especial distrust...." [3]

Natural history has become old-fashioned, perhaps, but is as relevant as it ever was, if not more so, due to rapid changes we, in our naivety as human beings, have occasioned in the natural world. Naturalists have for centuries recorded their observations for pleasure and interest. We are now placed in a position of duty to do so, to monitor changes and to record natural phenomenon that are predicted to change or vanish within a few generations. Duty aside, many will continue to be driven by intelligent

curiosity, as epitomized by the following quote by Robert Cushman Murphy who gives natural history, as a science, full sway. [4]

"I took *Notes of a Naturalist* during the voyage of the Beagle to my chair atop the cabin, and for several hours have wandered again with Darwin over the pampas of Patagonia, through the Galapagos Isles, across the Pacific to Tahiti, and then on to Keeling in the Indian Ocean. How I long to see with the eyes of that matchless man of science and to write with his pen! When I come home, I must study more geology. I want to be able to grasp something of the whole scope of nature in the lands and seas I visit; to be broad, not narrow; to be both naturalist and humanist, not a mere specialist. In technical work a man of this age must specialize, but in a reconnaissance of a part of the earth's face, whether soil or sea, I want my comprehension, like that of Charles Darwin, to be able to interpret the underlying significance of clouds, hailstones, argillaceous rock, hot springs, cacti, land planarians, ice-borne boulders, carrion beetles, wingless flies, graminivorous birds, nest building fish, viviparious reptiles, dodders, omnivorous rodents, sessile-eyed crustaceans, insect-eating plants, and foraminiferous protozoans! Nature is a chain, a million-knotted web or fishnet of life. Nothing exists of and for itself, but only in relation to other organisms, as Darwin seemed to know more thoroughly than anyone else."

Blue Jay is a journal of natural history, the science, and also nature appreciation, the humanist perspective. When natural history is the subject, accuracy and objectivity are essential, and articles submitted as natural history are given scientific review. When nature appreciation is the subject, the editorial criteria to be met are clarity, insight and a story worth telling.

As editors, we thank all those who contribute their time and expertise to the production of *Blue Jay*, as well as all who maintain an interest in regional natural history by subscribing to, and reading, the publication.

Footnotes

1. All the definitions in paragraph 2 and 3, except that of 'science' come from *The American College Dictionary* published in 1957 by Random House. The definition of 'science' comes from *Canadian Oxford Dictionary* published in 2004 by Oxford University Press.

2. Margaret Belcher's comprehensive history, *The Isabel Priestly Legacy: Saskatchewan Natural History Society, 1949-1990*, published by Saskatchewan Natural History Society in 1996, is the reference for information about the history of the Society and *Blue Jay*. Page numbers for the quotes refer to this book.

3. Don Gayton had used this quote as a frontispiece for his master's thesis as explained in his tribute to Stan Rowe in the September 2004 issue of *Blue Jay*.

4. This quote from Robert Cushman Murphy's *Logbook for Grace* (1947) appears in Steven G. Herman's *The Naturalist's Field Notebook: A Manual of Instruction Based on a System Established by Joseph Grinnell*, published in 1986 by Buteo Books, in Vermillion, South Dakota. The passage is from a journal Robert Murphy kept on a trip to the Antarctic as a naturalist on the whaling brig Daisy, 1912-13. Herman's 200 page *The Naturalist's Field Notebook* is recommended to any natural history note-taker interested in systematic journal keeping.

CATTLE EGRETS AND NESTS FOUND DURING FRANKLIN'S GULL SURVEYS IN SASKATCHEWAN IN 2006 AND 2007

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The Cattle Egret occurs with some regularity in prairie Canada and the first recorded observation of Cattle Egrets in Saskatchewan was 14-17 June 1974 at Eyebrow Lake.[6, 8] The first breeding record for Saskatchewan, 30 June 1981, was a pair nesting in a tree in a heronry occupied by Great Blue Herons and Black-crowned Night-Herons on Old Wives Lake.[4, 7, 8] The second breeding record was at Eyebrow Lake in 1994.[8] In 2005, a pair of Cattle Egrets displaying breeding behaviour was observed on 4 June at Stalwart Marsh National Wildlife Area (NWA) near Last Mountain Lake (Dave Duncan, Canadian Wildlife Service (CWS), pers. comm.). Phil Taylor (CWS, pers. comm.), confirmed breeding on 7 June at Stalwart Marsh NWA with the discovery of four nests perched in the Common Reed Grass and bulrush (*Scirpus* sp.) stands. This article reports Cattle Egret observations made in the spring and summer of 2006 and 2007 during surveys of Franklin's Gull colonies by my field crew and myself at Stalwart Marsh NWA, Middle Quill Lake and Goose Lake.

Stalwart Marsh NWA

On our visit to Stalwart Marsh NWA on 20 May 2006, we found the water levels were very high, flooding and destroying most of the bulrush stands in the basin and effectively eliminating the majority of the nesting habitat for colonial waterbirds, including the Cattle Egret. On that day we observed a single Cattle Egret walking along the shoreline of Stalwart Marsh in the basin where the birds nested in 2005.

Our next visit to Stalwart Marsh NWA was on 18 May 2007. Water levels were as high or higher than in the previous year and there was limited emergent vegetation around the perimeter of the basin. No Cattle Egrets were observed in the area that day.

Middle Quill Lake

During a visit to Middle Quill (Mud) Lake on 17 May 2006 to map the boundary of the Franklin's Gull colony within the bulrush habitat, we observed three adult Cattle Egrets flush from the bulrushes. On the next visit on 14 July, I observed over 50 adult Cattle Egrets flying above the colony's bulrush stand. I found nests on what appeared to be the edge of a Cattle Egret colony with two nests containing three and five eggs respectively. To reduce disturbance to the Cattle Egret colony, I did not search for or check other nests, although more were visible. No photos were taken of the nests or nesting colony. Assuming that all the adults flying above the colony were off their nests, then there would be a minimum of 25 pairs or nests in the colony. It is

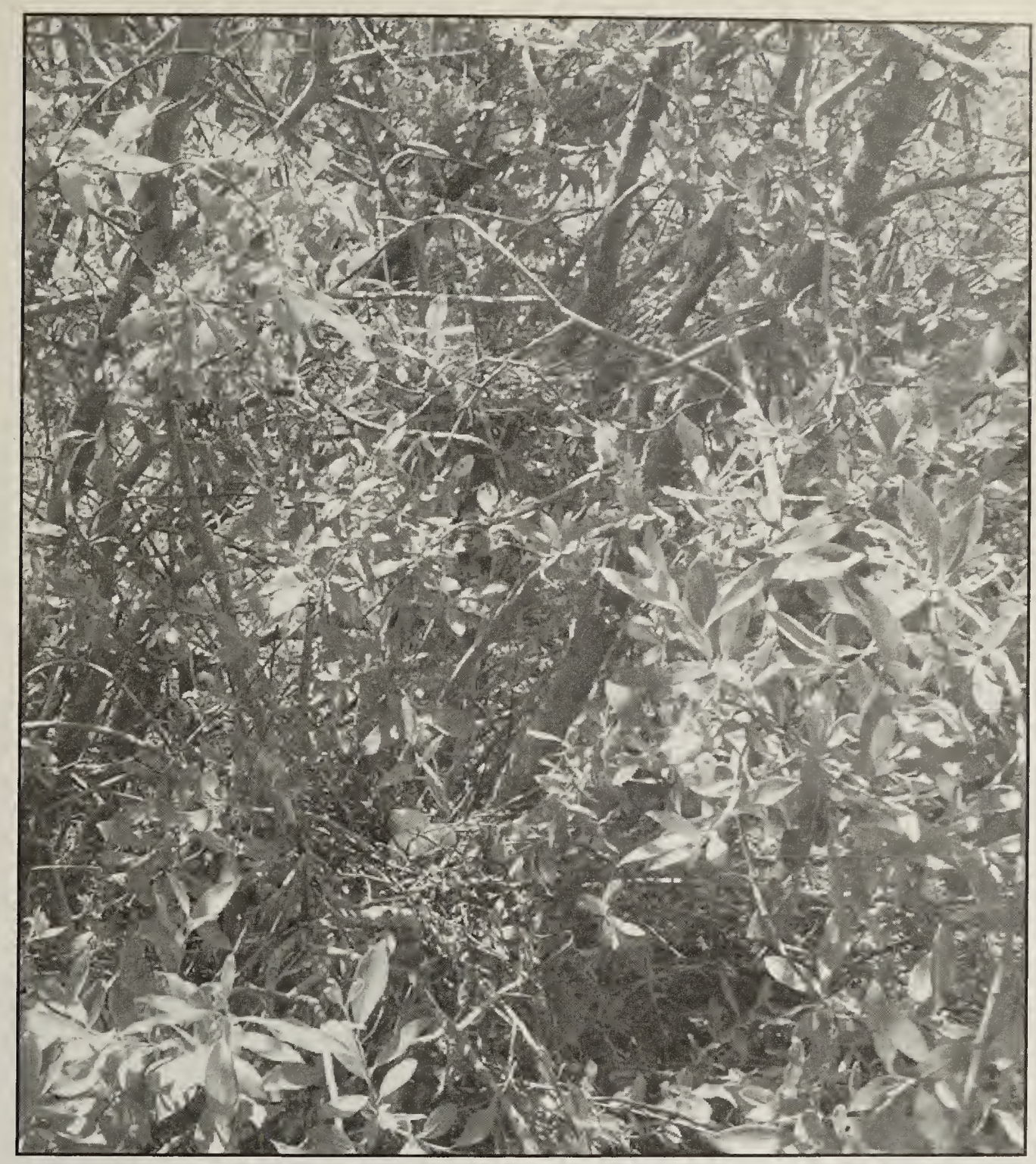

Figure 1. Cattle Egret nests in willow at Middle Quill Lake, SK on 13 June 2007. G. Beyersbergen

also possible that the flock of Cattle Egrets observed by numerous observers beginning in early August at the Borsheim wetland 85 kilometres to the southwest came from the Middle Quill Lake colony.[2]

On 19 May 2007, when we next visited Middle Quill Lake, water levels were extremely high and the bulrush stand where the Cattle Egrets had nested in 2006 was completely submerged. Six adult Cattle Egrets were feeding along the shoreline at the access point on the east side. About 100 m south of the access road, a minimum of 38 Black-crowned Night-Herons were nesting in a flooded willow stand. On 13 June 2007, we revisited the site and found the water levels had dropped slightly but were still high. We accessed the willow stand using a canoe and found six Cattle Egret nests, a minimum of 1.5 metres above ground, with recently abandoned eggs (Figures 1 and 2). No adult Cattle Egrets

Figure 2. Cattle Egret nest at Middle Quill Lake, SK on 13 June 2007.
G. Beyersbergen

Figure 3. Cattle Egret nest at Goose Lake, SK on 12 June 2007
G. Beyersbergen

were at the heronry or in the immediate vicinity. There also were no adult Black-crowned Night-Herons, but there were several dead or starving Black-crowned Night-Heron nestlings along with numerous predated eggs among 20 stick nests. It appears the Black-crowned Night-Herons shifted their colony to the bulrush stand about 200 metres north, where Franklin's Gulls, Western Grebes, and Eared Grebes were nesting, but no Cattle Egrets could be found. A third visit to the site on 17 July 2007 also failed to locate any Cattle Egrets. However, four adult Great Egrets were observed in the Black-crowned Night-Heron colony in the bulrush stand. We visited the Black-crowned Night-Heron colony by canoe but found no nesting activity of the Great Egrets.

Goose Lake

Several visits were made to Goose Lake in 2006 and on 18 July we noted a single Cattle Egret along the road near the shore of the east bay of the lake.

During the initial survey of the Franklin's Gull colony on 12 June 2007, we located a nest with four eggs (Figure 3) in the bulrush stand along with four Black-crowned Night-Heron nests. When we checked the nest on 15 July 2007 there were three young (Figure 4) and three adult Cattle Egrets in attendance at the nest site.

Our observations confirm that the range of the Cattle Egret continues to expand northwards in prairie Canada. In Alberta, although there are observations as far north as Jessie Lake, latitude: 54° 15' N, in 1994 and

Figure 4. Cattle Egret young in nest at Goose Lake, SK on 15 July 2007
G. Beyersbergen

the latest observation near Carseland in 2003,[5] the Cattle Egret is still classified as an Accidental/Vagrant species with no documented nesting in the province.[3] Manitoba's first documented nesting record was 1 September 2005 at Plum Lake, latitude: 49° 38' N.[1] In Saskatchewan, we now have documented nesting to the west of centre, with a single nest at Goose Lake, latitude: 51° 45' N and to the east, with a colony at Middle Quill Lake, latitude: 51° 56' N, which is the most northerly documented occurrence of breeding in the prairie region. Further studies and surveys of prairie region wetlands for waterbird nesting will continue to add to our knowledge of the Cattle Egret in our area.

Acknowledgments: Thanks to Bev Gingras, Wendy Calvert, Gillian Turney, Robin Bloom, Martin Schmoll and Lisa Mathias for their perseverance during the long Franklin's Gull surveys in Saskatchewan during which all of these rare sightings were recorded. Review of the manuscript by Wendy Calvert and Ron Bazin provided many helpful improvements.

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FIRST RECORD OF CASSIN'S VIREO FOR SASKATCHEWAN

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On 24 May 2002, the first author extracted an unusual bird from one of the 13 mist nets used in migration monitoring studies at the Last Mountain Bird Observatory (LMBO). The bird seemed to be an unusually pale Blue-headed Vireo, features that begged its consideration as a Cassin's Vireo or even a Plumbeous Vireo. As with any capture at LMBO, the bird was taken to the lab, weighed and measured, and given a numbered United States Fish and Wildlife Service aluminum band. As the bird had yet to be identified, Smith called the second author, who was working at Last Mountain Lake National Wildlife Area, to help document and photograph the bird before it was

released. In all cases but the Alder/ Willow Flycatcher complex, banded birds must be reported as species, not as unidentified birds. Until 1997[1], this was not a problem for the vireos as the Blue-headed, Cassin's and Plumbeous were considered one species, known as the Solitary Vireo.

During the breeding season, the ranges of the three are as follows. The Blue-headed Vireo, the common species in Saskatchewan, occupies the boreal forest region from southwestern Northwest Territories east to southwestern Newfoundland south through the northeastern United States and the Appalachian Mountains to Georgia. The Cassin's Vireo is found in the Coast Mountains from southwestern British Columbia, south through the western United States to Baja California, and in the Rocky Mountains in southern British Columbia, southwestern Alberta and the northwestern United States. The Plumbeous Vireo, with one sight record for the province,[4] ranges over the Rocky Mountains from southern Idaho south though the United States and Mexico to Guatemala and El Salvador.[1]

With a slate-blue head, greenish back and yellowish sides, the Blue-headed is the most brightly and boldly coloured of the three. The Plumbeous Vireo sits at the other end of the spectrum, being lead gray above and shading to paler gray below, sometimes with some yellow on its sides. The Cassin's Vireo is intermediate between the two in most characteristics. All three sport wingbars and white spectacles, betraying the common ancestry of the trio.[3]

As the LMBO bird showed a considerable amount of green above and yellow below, the possibility that the bird in question was a Plumbeous Vireo was soon discounted. The possibility that it was a Cassin's Vireo was, however, less easily dismissed. Heindel (1996) considered the chief differences between the Blue-headed and Cassin's vireos to be the cheek/ throat contrast, head colour, head/back contrast and the amount of white on the outermost tail feathers. Blue-headed Vireos have a blue-gray to gray head contrasting with a white throat, while Cassin's show much less contrast between its gray-green to green head and its off-white throat. The head colour of the Blue-headed Vireo also contrasts strongly with the colour of the back, which is bright green or bright green with gray; again with the Cassin's there is much less contrast between the head and olive back. Finally the Blue-headed has a broader white edging to the outermost tail feathers than the Cassin's.[3] Buckley noted further that in most or all Blue-headed Vireos, the white edging of the inner vanes usually widens to an upside down "V" at the tip.[2]

The bird captured at LMBO had features consistent with those of Cassin's Vireo. The LMBO bird had a gray green head, showing little contrast with its off-white throat and gray green back. The white edging on the outermost tail feathers was narrow and did not widen to a "V" on the inner vane. Olive-yellow flanks were evident on the bird. These diagnostic field marks can be seen in Figures 1 and 2 on the inside front cover.

The occurrence of Cassin's Vireo is not entirely unexpected as the species breeds in the mountains of southwestern Alberta. Summer sightings of "Solitary Vireos" in the Cypress Hills may also pertain to Cassin's Vireo. Last Mountain Bird Observatory is only 670 km from the former and 360 km from the latter. In

addition, we have recorded other mountain birds at the Observatory, including several each of the Audubon's race of the Yellow-rumped Warbler and MacGillivray's' Warblers.

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UPDATE ON CATTLE EGRET AND WHITE-FACED IBIS BREEDING ACTIVITY AT WHITEWATER LAKE, MB IN 2007

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Figure 1. Immature White-faced Ibis at Whitewater Lake, MB on 9 July 2007. Ron Bazin

Cattle Egrets and White-faced Ibis were observed nesting in Manitoba in 2007, following the first documented successful breeding in 2005 and additional observations in 2006.[1,2] The 2007 records for both species are from Whitewater Lake, a 9,000 ha saline wetland in southwestern Manitoba between the towns of Boissevain and Deloraine. Whitewater Lake was the location for the first White-faced Ibis breeding record in Manitoba in 2005 and the location for several small Cattle Egret colonies in 2006[1,2]. Of particular importance to a number of waterbird species, including Cattle Egrets and

White-faced Ibis, is a large managed wetland cell located at the east end of Whitewater Lake, which has a total area of 750 ha. There is also an adjacent smaller wetland cell with an area of 150 ha. The observations reported here were recorded during two separate visits to the lake, the first on 30 May-1 June and the second on 7-9 July.

Cattle Egret

During the 30 May-1 June visit made with G.W. Beyersbergen (Canadian Wildlife Service – Edmonton), no Cattle Egrets were observed. However, three Black-crowned Night-Heron colonies were noted on the lake on 1 June, each with approximately 40 adults and active nests with eggs. Two of the colonies were located just outside the large wetland cell at the east end of the lake, whereas the third was in the southwest corner. Cattle Egrets are known to nest in association with Black-crowned Night-Herons, but none were observed during this first visit.[3]

On the second visit, on 7-9 July, I discovered two separate Cattle Egret colonies. One colony, with approximately 30 adults, was found within the Black-crowned Night-Heron colony discovered in the southwest corner of the lake during the first visit. This colony was in the same location as two small Cattle Egret colonies discovered in 2006.[1] The Cattle Egret nests observed in this colony contained only eggs, whereas most of the Black-crowned Night-Heron nests contained nestlings in various stages of development.

The second and larger Cattle Egret colony was also in a Black-crowned Night-Heron colony located within the large wetland cell and in the same general area as nine small colonies observed in 2006.[1] The colony was centered within a zone of deep-water, emergent vegetation and was approximately 750 m from the nearest dyke. Approximately 100 Cattle Egret adults were observed, although more may have been hidden within the bulrush vegetation. To minimize disturbance, only the Cattle Egret nests located along the edge of the colony were checked. Those nests contained nestlings at various stages of development.

White-faced Ibis

Twelve White-faced Ibis were observed during the 30 May-1 June visit to the lake (five on 30 May and seven on 1 June), including two within the large wetland cell area. No nests were observed at this time.

During the 7- 9 July visit, I observed significantly larger numbers of White-faced Ibis, most within or just outside the large wetland cell. The maximum one-day count was 26 adults recorded on 9 July, all within the large wetland cell. On 8 July, 18 birds were observed within the lake itself of which nine were notably closer (within 350 m) to the dyke surrounding the large wetland cell than the remaining nine which where spread more throughout the rest of the lake. An additional White-faced Ibis was observed in the cell on 8 July. Considering their location near or within the cell, if these 10 birds are part of the 26 birds observed in the cell on 9 July, this would suggest an actual count of 35 White-faced Ibis on Whitewater Lake (26 within the large cell and 9 on the remainder of the lake).

Interestingly, despite the fact that the large wetland cell covers slightly less than 10% of the entire lake area, 75% of the total estimated number of White-faced Ibis occurred there. A little less than half of the 20 hours of intensive search effort occurred within the large wetland cell with the remaining time

spent covering the rest of the main lake. Though the smaller wetland cell was not searched, I viewed it from the surrounding dyke with a scope and did not observe any Cattle Egret, White-faced Ibis or Franklin's Gull colonies. The importance of this smaller wetland cell for other breeding waterbirds was not determined.

In the large wetland cell on 9 July, 10 White-faced Ibis nests were found, all within a large and extensive Franklin's Gull colony. Most of the White-faced Ibis nests were single nests separated from one another, with the exception of three nests situated together in a tight group. Nests were located within low- to moderate-density bulrush stands and were composed primarily of bulrush stems. Nest stages varied from eggs (maximum clutch size of 5) to recently hatched young (Figure 1).

The occurrence of Cattle Egret and White-faced Ibis nests in the large wetland cell highlights the importance of this managed area at the east end of Whitewater Lake as prime breeding habitat for these species. Additionally, this wetland cell provides crucial breeding habitat for other waterbird species, including a large number of Franklin's Gulls and important numbers of Eared Grebes, Black-crowned Night-Herons, American Coots and Black Terns.

Both wetland cells, managed by Ducks Unlimited Canada, allow for control of water levels which can be used to manage key breeding habitat within the cells for these species, particularly in years when breeding habitat may not be readily available on Whitewater Lake itself. For example, prior to 2006, Franklin's Gulls nested regularly within a large area of emergent vegetation in the centre of Whitewater Lake. A survey of that colony in 2004 provided an estimate of just over 200,000 breeding birds. As a result of significant rain events during the 2005 nesting season, there was a large increase in the water level of Whitewater Lake that resulted in the destruction of the entire Franklin's Gull colony and the complete elimination of the emergent vegetation in the centre of the lake. A significant portion of this large Franklin's Gull colony subsequently moved into the large wetland cell in the following years. Proper water level and habitat management within the wetland cells can therefore help to ensure that sufficient habitat remains available for breeding waterbirds returning to this globally significant wetland.

Acknowledgements

The author would like to thank Gerry Beyersbergen and Bryce Hoye for assistance in the field, and Gerry Beyersbergen, Paul Goossen and an anonymous reviewer for providing helpful comments on an earlier draft of this article.

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CLIFF-NESTING BARN SWALLOWS

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Figure 4. Nest 1 with 5 eggs on June 9, 2007. *D. Raitt*

Of Barn Swallow nesting, *The Birds of North America* states: "originally nesting primarily in caves, the Barn Swallow has almost completely converted to breeding under the eaves of or inside, artificial structures such as buildings and bridges. In North America, this shift in nest sites began before European settlement and was virtually completed by the mid-twentieth century; nowadays natural nestings are rarely seen and usually reported in print if they occur."[2] Speich et al. reported "a review of barn swallow nestings in natural sites reveals that few reported natural nest sites are presently active in North America."[4] A natural nesting occurrence in Wisconsin consisted of three Barn Swallow nests "about eight feet above the water and...well protected from above by the overhanging sandstone cliff."[1] Richard Knapton reported Barn Swallows nesting on Mason Island in Dawson Bay, Lake Winnipegosis in Manitoba where "three of the nests were built in natural cavities of the rock, and three were built on the cliff face itself."[3]

I observed Barn Swallows nesting on the rock face of an island in Bradley Lake, Manitoba (about 40 km southeast of The Pas), in the summer of 2007. The island is largely rectangular (approximately 130 meters by 40 meters) and is angled from southwest to northeast. The nests were on the southeast, east, and north faces of the island.

Field Observations, 2007

On March 24, I snowshoed in to the site and found 18 mud nests that I believed were made by Barn Swallows, and one stick nest of unknown origin. The mud nests varied from half cups

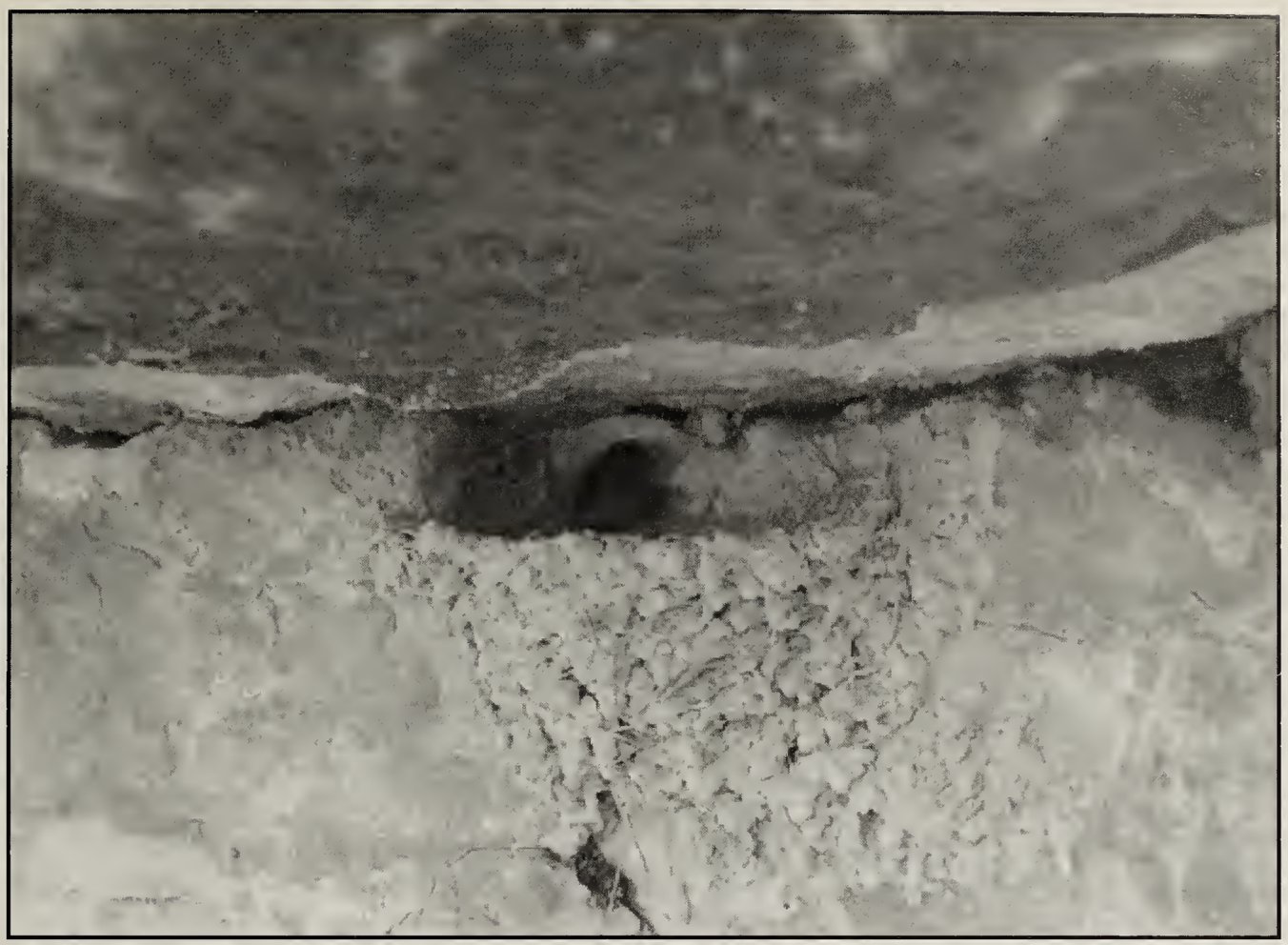

Figure 2. Nest 4, attached to a vertical surface protected by a rock overhang. This nest, photographed on July 13, was built after an earlier nest at this location had fallen from the cliff. *D. Raitt*

Figure 3. Nest 2, built in a small rock crevice. Note the build-up of droppings at the entrance. Photographed on June 9, 2007. *D. Raitt*

Table 1. Contents/condition of Barn Swallow nests monitored on Bradley Lake, Manitoba, June 9 - July 13, 2007

Date	Nest 1	Nest 2	Nest 3	Nest 4	Nest 5
June 9	5 eggs	5 eggs	6 eggs	6 eggs	not found yet
June 22	4 young and 1 egg - young probably ~24 hours old +/- 12 hours - 3 chicks became active when I was photographing - probably begging for food	2 young and 3 eggs - chicks likely < 24 hours old, and probably < 12 hours old - no movement	6 eggs attended by adult	6 eggs attended by adult	5 eggs attended by adult
June 29	3 young confirmed - room for more	5 young confirmed	3 young confirmed (possibly more)	nest fallen - fresh mud and vegetation at the site - later observed barn swallow sitting at site (probably rebuilding)	unknown (not monitored) - I went to the wrong nest
July 6	3 young	1 young (possibly more)	3 young (possibly more - probably not)	rebuilt nest - 2 eggs confirmed - possibly a 3rd egg - hard to see	empty except for feathers
July 13	empty - assumed fledged	2 young in nest - possibly more - blood quill sheathes vissible on retrices of tail sticking above rim of nest	fate unknown - nest broken - part of rim hung up on vegetation outside of nest crevice - one egg present	rebuilt nest - 5 eggs in nest	did not monitor

stuck on vertical rock surfaces (Figures 1 and 2) to open cups supported by rock underneath, e.g. in a small rock crevice (Figure 3). In all cases the nests were protected from above by rock overhangs. The season the nests were built or used was unknown, so these 18 nests may represent several years of use.

On May 7, 2007, the year's first Barn Swallows in The Pas area were reported to me by Darryl Langlois of The Pas. On May 17, I saw (from the mainland) Barn Swallows flying around the island on Bradley Lake where the nests were previously noted. Between June 9 and July 13, I visited the Bradley Lake site five times by boat to record activity. During this period, I made observations on five active nests (Table 1). Active nests were chosen for monitoring if they could be approached without damaging them or other nests, and if the contents could be viewed (from the boat) either directly or with the aid of a mirror. In many cases, due to the close proximity of rock overhangs, a mirror was held over the nest, and digital photographs were shot up toward the mirror. The digital photos were later reviewed to confirm the nest contents. Due to other commitments, I was unable to continue monitoring nests after July 13, 2007.

At two locations, I noted active Barn Swallow nests within 60 cm of another active Barn Swallow nest.

On July 6, 2007, I noted that, including the 5 nests I was monitoring, there were 12 active nests, and probably 4 or 5 more. Based on the number of swallows in the area and the difficulty in locating all nests, I think there may have been as many as 24 nests.

The discrepancy between my high estimate of 24 nests and the 18 located on March 24, 2007 is due in part to the fact that in March I neglected to search the north face of the island. I had incorrectly assumed that it would not be used because of its exposure to the prevailing winds. Approximately 200 meters southwest of the nesting island there is another island with similar rock faces. The island is approximately 4 to 5 times larger than the nesting island. In 2007, I saw no evidence of use there by Barn Swallows.

Speich et al. noted that possible reasons for the lack of information on natural nesting sites for Barn Swallows might be their occurrence "in remote and generally inaccessible areas where they are unlikely to be discovered," and "observers may be unaware of the significance of natural nestings and, therefore, fail to report such observations."[4] In the case of Bradley Lake, the nesting site is seen by many people every year. The lake is a fairly popular fishing location (stocked with smallmouth bass), easily accessible, with a boat launch.

Acknowledgements

I wish to thank University College of the North for providing a boat, motor, and trailer for use in accessing the nesting island.

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THE PRAIRIE GOOSEFOOTS

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Introduction

In this article I will: (1) discuss the taxonomy, habitat, distribution, status and economic impact of the goosefoot (*Chenopodium*) genus, (2) describe the general characteristics of the goosefoots, and (3) present a taxonomic treatment of the genus consisting of a dichotomous key and descriptions of those species found in the Canadian prairies. All of the species described also occur in the United States.

The common name goosefoot refers to both the family Chenopodiaceae and the genus *Chenopodium*. In this paper, it will refer to the latter. The common name goosefoot is a literal translation of the scientific name based on the Greek words *chen* meaning goose and *pous* meaning foot. This name refers to the leaf shape of some species in this group. The goosefoots are often overlooked due to their small, inconspicuous flowers. In North America, the goosefoot genus consists of only 34 species. In the prairie provinces of Canada, there are 20 species in total, six of which are introduced from Eurasia. The genus has been recently reviewed taxonomically by the Flora of North America [24] committee and there are now twice as many species in the prairie provinces as reported in earlier floras [14, 19] due to recent discoveries and taxonomic "splitting" of species like Narrow-leaved Goosefoot (*C. leptophyllum*). Identification of goosefoot species can be difficult due to the variable nature of the leaves, and close examination of the fruits is often needed for confirmation.

Habitat and Distribution

Goosefoot species occur mainly in dry, saline and disturbed habitats. They have a number of adaptations that make this possible. Succulent leaves store water for use in times of drought and narrow leaves have less surface area from which water can evaporate, both of which increase water use efficiency. [3, 13] An annual habit means that goosefoot seeds can remain dormant until conditions are moist enough to support their growth. Many goosefoot species also are tolerant of saline conditions. Surviving in saline soils requires that the plant maintain a high enough concentration of salts that saline water will continue to flow into the roots. However, as salts can be harmful to plant cells, some method of dealing with the salts is needed. Many goosefoot species store salts in special inflated hairs, called salt glands or bladders.[3] The presence of these glands gives goosefoots their "scurfy" or "mealy" appearance. Succulence also contributes to salt tolerance because the stored water dilutes the salts, making them less harmful. [3, 13]

Most goosefoot species in the prairie provinces occur in the Prairie ecozone.[1] The species with narrow leaves are typically found on dry, sandy soils in the plains while those with wider leaves are generally found in moister conditions at the edges of woodlands

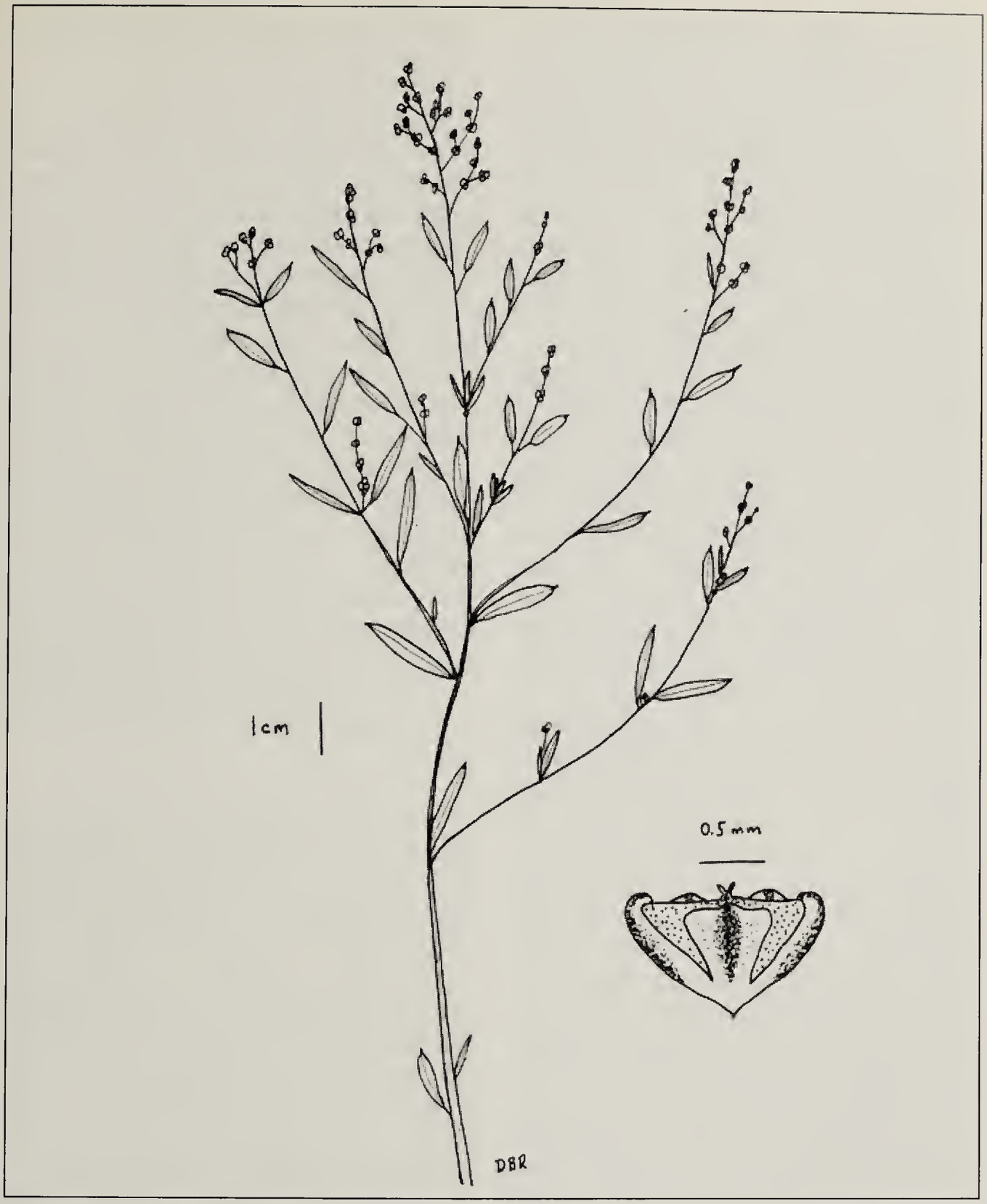

Figure 1. Chenopodium subglabrum. *D.B. Robson.*

or among bushes. Saline (*C. glaucum*) and Red Goosefoot (*C. rubrum*) are commonly found around saline wetlands.[4] The native species that are fairly common in the Boreal Plains ecozone are Strawberry Blight (*C. capitatum*), Berlandier's Goosefoot (*C. berlandieri*) and Maple-leaf Goosefoot (*C. simplex*).[1, 4] Introduced species are typically found along roadsides, disturbed areas, and in cultivated fields and gardens.[24] Lamb's-quarters (*C. album*), the most common introduced goosefoot species, is found in the Prairie, and Boreal Plain and Shield ecozones as far north as Churchill in Manitoba, Lake Athabasca in Saskatchewan and Peace River in Alberta.[23]

Status of the Goosefoots in Canada

Of the 14 native species found in the

prairies, seven are relatively rare. Smooth Goosefoot (*C. subglabrum*) is considered nationally threatened and is protected under the *Species at Risk Act* (Figure 1).[17] Smooth Goosefoot is restricted to sand dunes and uncultivated sand plains in the prairie provinces.[17] Two other goosefoot species are considered nationally rare: Narrowleaf Goosefoot (*C. leptophyllum*) and Dakota Stinking Goosefoot (*C. watsonii*).[2] Narrowleaf Goosefoot is found on sandy soils in all three prairie provinces while Dakota Stinking Goosefoot has been found on heavily eroded, clayey soils along river valleys in southern Alberta and Saskatchewan.[12, 16] Dark Goosefoot (*C. atrovirens*) and Mealy Goosefoot (*C. incanum*) are considered provincially rare in Alberta and Saskatchewan.[10, 12] Hians' Goosefoot (*C. hians*) is rare in Saskatchewan with only one confirmed specimen ever being found.[10] Arid Goosefoot (*C. dessicatum*) is considered rare in Alberta and uncommon in Saskatchewan.[10, 12] In addition to growing in relatively uncommon habitats, the rarity of these species is due in part to their annual habit; they appear to germinate erratically and are thus temporally rare.[16, 17] It is possible that these species are adapted to the soil disturbances made by herds of migratory Bison, as well as rodents like the Black-tailed Prairie Dog.[16] In recent times, rare goosefoot plants have been found in areas of native grassland that have been heavily grazed and trampled by cattle, further lending support to this hypothesis.

Four of the native species are considered to be weeds of gardens, waste areas, roadsides and edges of cultivated fields, namely Berlandier's Goosefoot, Strawberry Blight, Maple-leaf Goosefoot and Saline Goosefoot.[18] Berlandier's Goosefoot is of particular concern as it is an intermediate host to the crop pest, beet leafhopper.[18]

Six species of goosefoot are introduced from Eurasia. One of these species, Lamb's-quarters, is a common agricultural weed although it is also eaten as a potherb in many countries.[18] Lamb's-quarters is the alternate host for a number of viral crop diseases.[18] The potherb Good King Henry (*C. bonus-henricus*) is sometimes cultivated in prairie gardens and occasionally escapes but has not become a serious weed.[4] The remaining four introduced species (*C. foliosum*, *C. murale*, *C. polyspermum* var. *acutifolium* and *C. strictum*) are relatively uncommon weeds moving north from the United States, but they have the potential to become more troublesome, especially if climate warming makes conditions in the prairies more suitable for their growth.[9]

The rarity of many goosefoot species as well as their potential to become crop weeds in a changing climate makes collection and identification of plants in this genus extremely important. Unusual specimens observed are therefore worth collecting and donating to herbaria to better determine the distribution and frequency of these species.

Economic Impact of Goosefoots

The goosefoot family contains many of the species that we consider to be weeds including Russian Pigweed (*Axyris amaranthoides* L.), Russian-thistle (*Salsola tragus* L.) and Summer Cypress (*Kochia scoparia* (L.) Schrad.). However, it also contains several highly nutritious species such as Beet and Swiss Chard (*Beta vulgaris* L.), Spinach (*Spinacia oleracea* L.), and the wild forage plant Winterfat (*Krascheninnikovia lanata* (Pursh) Meeuse & Smit).

The goosefoot genus has several species that are grown as crop plants. Quinoa (*Chenopodium quinoa* Willd.) was originally cultivated by the Incas of Peru over 5,000 years ago.[7] Quinoa fell out of favour as modern crop plants spread, but is still in cultivation today as it is relatively drought, frost and salt-tolerant making it an excellent crop plant in adverse growing conditions.[7, 11] Quinoa is very nutritious due to the high protein content.[23] In fact, it is one of the only foods with all nine essential amino acids, making it nutritionally valuable for vegetarians in particular.[23] Raw Quinoa must first be rinsed to remove the bitter and mildly toxic saponins from the seed.[7] Due to the lack of the protein gluten, Quinoa can be eaten by people with a gluten (i.e. wheat) allergy. The seeds can be cooked like rice or couscous, or ground up and used as flour.

Other important pseudograins in this genus include Kaniwa (*C. pallidicaule* Aellen), which is still grown in Peru and Bolivia, and Pitseed Goosefoot or *huauzontle* (*C. berlandieri* Moq. ssp. *nuttalliae* (Saff.) H. D. Wilson & Heiser), which is still grown in Mexico.[23] Pitseed Goosefoot was one of the crops in the Eastern agricultural complex, a group of plants that were cultivated by First Nations in the east and midwestern part of the United States.[8] Pitseed Goosefoot was grown along with Squash (*Cucurbita pepo* L.), Little Barley (*Hordeum pusillum* Nutt.), Erect Knotweed (*Polygonum erectum* L.), Maygrass (*Phalaris caroliniana* Walter), Sumpweed or Marshelder (*Iva annua* L.), and Sunflower (*Helianthus annuus* L.), starting approximately 2,000 years ago.[20] About 1,100 years ago cultivation of these early crop plants was slowly abandoned in favour of a new, cold-tolerant variety of maize (*Zea mays* L.).[8] The arrival of Europeans in the late 1400s led to the further abandonment of these species in favour of Old World crops. Active suppression of the use of some traditional crops also occurred: the Incas considered Quinoa sacred, so Spanish conquistadors discouraged them from growing this plant as a method of cultural subjugation.[25]

Several species of goosefoots are grown mainly for their leaves: Lamb's-quarters, known in Europe as Fat Hen; Good King Henry; Jerusalem Oak (*Chenopodium botrys* L.); Foetid Goosefoot or *yerba del zorillo* (*C. graveolens* Willd.); and Wormseed or *epazote* (*C. ambrosioides* L.).[7, 22, 23] The first three plants are native to Europe and have become naturalized in many places around the world including Canada. Archaeological evidence suggests that Lamb's-quarters may have been grown for its seeds during the Neolithic Age by Europeans before crops from the Middle East came to dominate the agriculture of the region.[5, 21] Lamb's-quarters and Good King Henry have highly nutritious leaves that can be eaten raw in a salad or cooked like spinach.[23] Jerusalem Oak leaves are eaten like spinach but also used as an herb. Foetid Goosefoot leaves are edible but toxic in large quantities and uncommon outside Latin America.[22, 23] Mexicans use Wormseed as an herb in a wide range of traditional dishes.[22] Wormseed is also grown for its oil, which is useful for expelling intestinal worms.[22] All five of these plants are rarely available commercially in North America, being grown only occasionally in home gardens.

As goosefoot plants are wind-pollinated, they may cause rhinitus or hay fever in sensitized people.[6] Goosefoot plants typically flower in summer and fall and can produce copious quantities of pollen. Although

all goosefoot plants can potentially cause hay fever, the species most likely to affect people is Lamb's-quarters as it is widespread, abundant and present in disturbed, urban and agricultural habitats.[6] People with summer and fall hay fever should avoid growing goosefoot plants like Good King Henry in their gardens, or alternatively consume the plants before they flower to prevent exposure.

Description of *Chenopodium* [4, 14, 15, 24]
This genus contains mainly annual, but also a few perennial, herbs that are glabrous (i.e. smooth, lacking hairs or glands) or farinose (i.e. covered with small, white bladders). The stems are erect to prostrate, typically branched and unarmed. The leaves are alternate on the stem, stalked or rarely sessile, linear, oblong, lanceolate, ovate, triangular or rhombic in shape, with margins that are entire, toothed, wavy or lobed, and often farinose. The inflorescences consist of terminal or axillary, spikes or panicles of glomerules (i.e. dense, often rounded clusters of flowers). The flowers are small, greenish, with no bracts or petals, 3-5 sepals that are keeled or rounded and may be fused at the base, 5(1) stamens, 2 stigmas, and a superior ovary. The fruit is an achene or a utricle, and may be covered by the sepals at maturity. An achene is a one-seeded fruit with a firm, close-fitting pericarp (i.e. fruit wall) not easily separated from the seed, while a utricle is one-seeded fruit with a thin, bladdery, inflated pericarp that is readily separable from the seed. The pericarp is smooth or variously textured. The seeds can be vertical or horizontal (Figure 2), lens-shaped to rounded, black, brown-black or reddish brown, smooth, warty, rugose (i.e. wrinkled), punctate (i.e. pitted) or with a honeycombed texture.

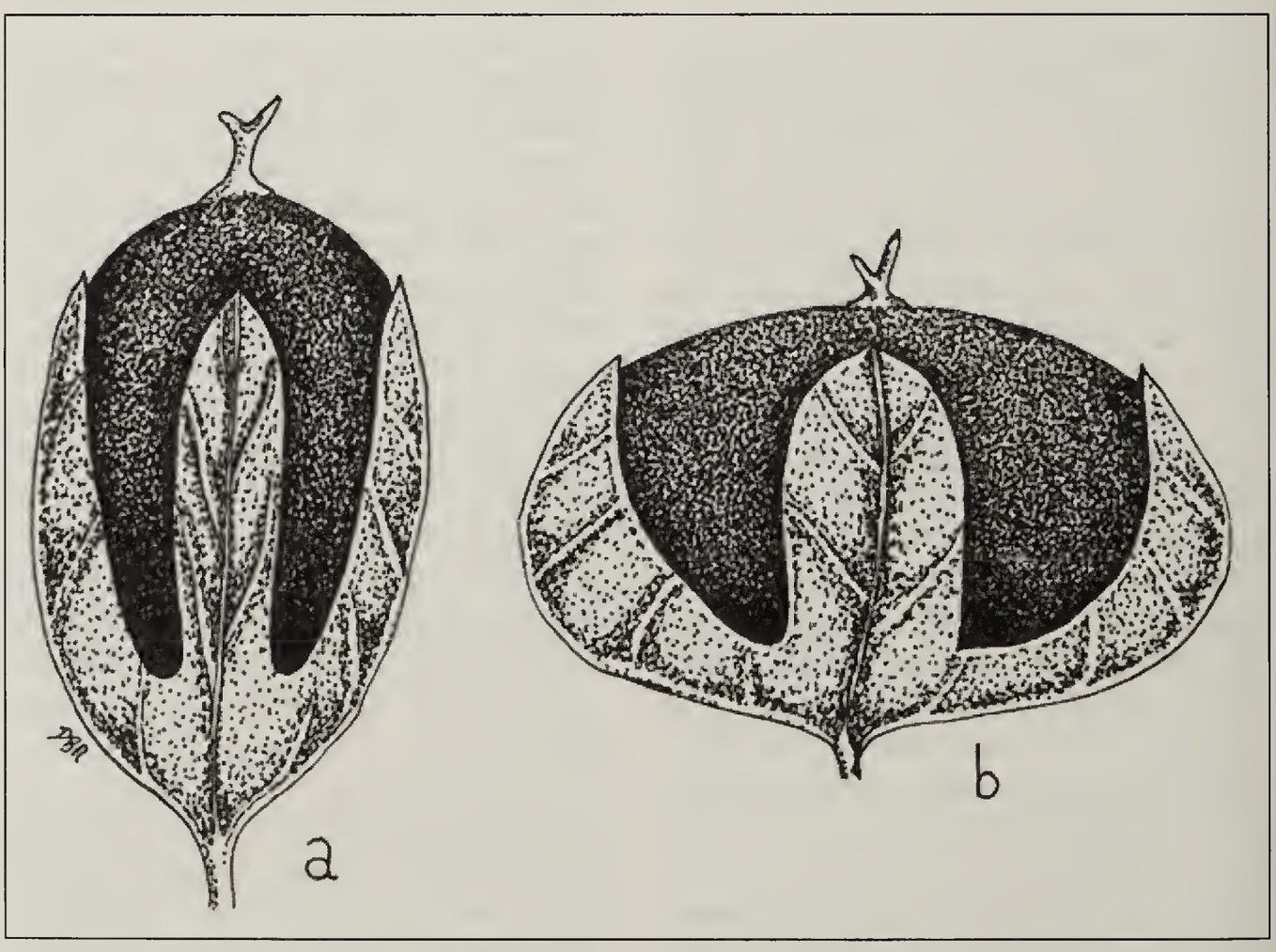

Figure 2. Vertical (a) and horizontal (b) fruits in the goosefoot genus.
D.B. Robson

Identification Key to the Goosefoots of the Prairies [4, 14, 15, 24]

1a. Calyx fleshy, red, and globular, resembling a small strawberry 2

1b. Calyx not fleshy, red, and strawberry-like 3

2a. Leaf-like bracts present throughout the flower spike; flowers maturing from base upwards; 1 stamen ..... *C. foliosum*

2b. Leaf-like bracts present only in lower half of the flower spike; flowers maturing from top downwards; 3 stamens ..... *C. capitatum*

3a. Leaves mostly linear, occasionally linear-lanceolate or oblong-ovate, 2-3 times longer than wide or longer; entire or with two basal lobes 4

3b. Leaves deltoid, rhombic, oblong or ovate; to 2 times longer than wide; entire, toothed or lobed 9

4a. Leaves with 1 vein, blades linear, margins entire 5

4b. At least the lower leaves with 3 veins from the base, blades linear to lanceolate, margins may have 2 basal lobes 6

5a. Leaves glabrous to very sparsely farinose, fleshy; fruit a utricle (with a loose, inflated pericarp); seeds 1.3-1.5 mm in diameter ..... *C. subglabrum*

5b. Leaves moderately to densely farinose, not fleshy; fruit an achene (with a close-fitting pericarp); seeds 0.9-1.2 mm in diameter ..... *C. leptophyllum*

6a. Sepals covering the fruit at maturity ..... *C. dessicatum*

6b. Sepals not covering the fruit at maturity 7

7a. Leaves 1.5-3 times longer than broad, lower surface almost glabrous; glomerules in a loose panicle-like inflorescence; pericarp smooth..... *C. atrovirens*

7b. Leaves 3 times longer than broad, lower surface farinose; glomerules in dense spikes or panicles; pericarp smooth or warty 8

8a. Fruit a utricle (with a loose, inflated pericarp); pericarp smooth; seeds rounded; lower leaves often with two prominent basal lobes or teeth ..... *C. pratericola*

8b. Fruit an achene (with a close-fitting pericarp); pericarp with small warts; seeds flattened; lower leaves entire ..... *C. hians*

9a. Seeds vertical, or both vertical and horizontal 10

9b. Seeds all horizontal 12

10a. Plants perennial; sepals 5; seeds more than 1.5 mm in diameter; fruits are achenes (with a close-fitting pericarp) ..... *C. bonus-henricus*

10b. Plants annual; sepals 3 or 4; seeds less than 1.5 mm in diameter; fruits are utricles (with a loose, inflated pericarp) 11

11a. Leaves farinose, the underside white; seeds rugose-punctate..... *C. glaucum*

11b. Leaves glabrous, the underside not white or sparsely white, usually blackening upon drying; seeds smooth ..... *C. rubrum*

12a. Mature plants short, up to 25 cm high 13

12b. Mature plants tall, up to 50 cm high 14

13a. Plants up to 15 cm high when mature; fruit a whitened achene (with a close-fitting pericarp); leaves with a fishy scent when bruised ..... *C. watsonii*

13b. Plants up to 25 cm high when mature; fruit a utricle (with a loose, inflated pericarp); leaves lacking a fishy scent ..... *C. incanum*

14a. Flowers individually arranged in panicles; leaf blades glabrous 15

14b. Flowers in loose or dense glomerules; leaf blades usually farinose ... 16

15a. Leaves wavy to toothed; seeds 1.3-1.9 mm in diameter ..... *C. simplex*

15b. Leaves entire; seeds 0.8-1.3 mm in diameter. ..... *C. polyspermum*

16a. Seeds deeply honeycomb-pitted ..... *C. berlandieri*

16b. Seeds warty or smooth 17

17a. Leaves triangular; margins entire, lobed or toothed 18

17b. Leaves ovate to broadly ovate, rhombic or lanceolate; margins lobed or toothed 19

18a. Leaf blades toothed and sometimes with basal lobes, older leaves glabrous ..... *C. murale*

18b. Leaf blades with basal lobes but not toothed; leaf blades usually farinose ..... *C. fremontii*

19a. Leaf margins tapering to an acute apex; leaf blades stalked and ovate, rhombic or lanceolate; seeds circular in outline ..... *C. album*

19b. Leaf margins roughly parallel below the obtuse apex; leaf blades sessile and lanceolate to narrowly elliptic; seeds oval in outline ..... *C. strictum*

Descriptions of Goosefoot Species [4, 10, 12, 14, 15, 19, 24]

The plants are arranged alphabetically according to their scientific names since many of the plants have more than one common name. After each scientific name there is a list of the synonyms for that species. (A synonym is a name that formerly was used for the plant.) The flowering period is noted in the descriptions; it can vary considerably depending on the geographic location and weather conditions.

1. *Chenopodium album* L. - Lamb's-quarters or White Pigweed

[*C. a.* ssp. *dacoticum* Aellen; *C. a.* var. *fallax* Aellen; *C. a.* var. *lanceolatum* (Muhl. *ex* Willd.) Coss. & Germ.; *C. a.* var. *polymorphum* Aellen; *C. amaranticolor* Coste & Reyn; *C. giganteum* D. Don; *C. lanceolatum* Muhl. *ex* Willd.; *C. paganum* auct. non Reich.; C. *suecicum* Murr.]

An erect to sprawling annual, 20-80 cm high, simple to much branched, usually with reddish striped stems. Leaves with 1-2.5 cm stalks, ovate, rhombic or lanceolate with an acute to subobtuse apex, usually wavy-margined, farinose, 1-6 cm long and 0.5-4 cm wide. Inflorescence in terminal and axillary panicles of dense glomerules. Sepals 5, not fused, the lobes ovate, keeled and obtuse at the apex, largely covering the fruit at maturity. Fruits horizontal, smooth to bumpy utricles. Seeds black, smooth to finely rugose, circular in outline and 0.9-1.6 mm in diameter. June-September. An introduced, highly variable, and common weed found in waste places, roadsides, and gardens throughout the prairie provinces.

2. *Chenopodium atrovirens* Rydb. - Dark Goosefoot or Pinyon Goosefoot

[*C. aridum* A. Nels.; *C. fremontii* S. Wats. var. *a.* (Rydb.) Fosberg; *C. incognita* Wahl; *C. wolfii* Rydb.]

An erect to semi-erect annual, 10-50 cm tall, usually with many ascending to arched or drooping branches. Leaves with 0.5-1.5 cm stalks, ovate, oblong or oval, 3-veined, obtuse to rounded at apex, rounded to cuneate at base, margins entire or rarely with two basal lobes, sparsely farinose initially becoming glabrous, 1-3 cm long and 0.4-2.2 cm wide. Inflorescence consists of dense glomerules in terminal and axillary paniculate spikes. Sepals 5, not fused, with obovate lobes that are sparsely farinose and with a rounded or notched apex that does not cover the fruit at maturity. Fruits horizontal, smooth achenes or utricles. Seeds dark red-brown to black, shiny, obscurely wrinkled, lens-shaped and 0.9-1.3 mm in diameter. July-September. Native and rare in open disturbed sites, generally at higher elevations in Alberta and Saskatchewan.

3. *Chenopodium berlandieri* Moq.-Tandon var. *zschackei* (Murr) Murr - Pit-seed Goosefoot or Net-seed Lamb's-quarters

[*C. acerifolium* Andrz.; *C. album* L. var. *b.* (Moq.) Mack. & Bush; *C. b.* ssp. *z.* (Murr) A. Zobel; *C. b.* var. *farinosa* (Ludwig) Aellen; *C. b.* var. *platyphyllum* (Issler) Ludwig; *C. b.* var. *z.* Murr.; *C. boscianum* auct. p.p. non Moq.; *C. z.* Murr.]

An erect to ascending annual, 10-100 cm high, simple to much branched and farinose. Leaves with 0.2-9 cm stalks, rhombic or deltate, with an acute to acuminate apex, base cuneate to truncate, margins entire, toothed and often with 2 basal lobes, farinose, 1.7-4 cm long and 0.5-3 cm wide. Inflorescence consists of glomerules in compound spikes. Sepals 5, not fused, with ovate to deltate lobes that are farinose, often keeled and with an obtuse apex, sometimes covering the fruit at maturity. Fruits horizontal achenes or

utricles that are honeycomb-pitted. Seeds brown to black, honeycomb-pitted and 1.2-1.5 mm in diameter. August-September. Native, widespread and common in the grasslands, parklands and boreal forests of the prairie provinces.

4. ***Chenopodium bonus-henricus*** **L. - Good King Henry, Fat-hen or Wild Spinach**

A perennial herb with erect to ascending, unbranched stems up to 75 cm. Leaves with 1-12 cm stalks, triangular to hastate, apex acute, base truncate, cordate or hastate, margins entire, glabrous or slightly farinose, 4.5-10 cm long and 3-9 cm wide. Flowers in dense, bractless glomerules on terminal and axillary spikes, 5-19 cm long. Sepals 5, partly fused at base, apex obtuse, rounded or truncate, glabrous, not covering fruit at maturity. Fruits vertical and horizontal achenes. Seeds round, black, wrinkled and 1.5-2 mm in diameter. July-September. An introduced potherb that occasionally escapes from gardens.

5. ***Chenopodium capitatum*** **(L.) Ambrosi var. *capitatum* - Strawberry-blight, Indian-paint, Indian Ink**

[*Blitum capitatum* L.]

An annual herb, erect or spreading, to 50 cm high. Leaves with 1-12 cm stalks, triangular or ovate, apex acute to acuminate, base cuneate, truncate or hastate, margins entire or dentate, glabrous, 3-10 cm long and 1-9 cm wide. Inflorescence consisting of spikes with 3-10 mm diameter glomerules, at intervals on the stem, turning red and resembling small strawberries, with leaf-like bracts only in the upper half of the spike; flowers maturing from apex to base. Sepals 3, partly fused at base, with lanceolate to ovate lobes and an acute apex, covering fruit at maturity. Stamens 3. Fruits horizontal, ovoid, fleshy, red achenes. Seeds rounded, black, reticulate-pitted and 0.7-1.2 mm in diameter. June-August. Native and common on rocky or stony soil, around bluffs and woodlands, and along roadsides throughout the prairie provinces, particularly in boreal forest.

6. ***Chenopodium desiccatum*** **A. Nelson - Arid Goosefoot, Arid-land Goosefoot**

[*C. leptophyllum* (Moq.-Tandon) Nutt. *ex* S. Wats. var. *oblongifolium* S. Wats.; *C. l.* auct. p.p. non (Moq.) Nutt.; *C. o.* (S.Wats.) Rydb.; *C. pratericola* auct. non Rydb.; *C. p.* Rydb. ssp. *d.* (A. Nels.) Aellen; *C. p.* var. *o.* (S.Wats.) Wahl]

A spreading to erect annual, 1-14 cm tall, usually branched from the base and densely farinose. Leaves with 0.3-0.4 cm stalks, linear to narrowly lanceolate, oblong-elliptic or ovate-lanceolate, at least the lower leaves with 3 veins, somewhat fleshy, apex acuminate, base cuneate, margins entire, 1.5-2.5 cm long and 0.4-0.6 cm wide. Inflorescence consists of glomerules in terminal and axillary panicles. Sepals 5, not fused, with obovate lobes, densely farinose and with an obtuse apex, covering the fruit at maturity. Fruits horizontal, smooth, ovoid utricles. Seeds black, wrinkled and 0.8-1.1 mm in diameter. July-September. Native and uncommon or rare in undisturbed saline soils of Alberta and Saskatchewan.

7. ***Chenopodium foliosum*** **(Moench) Ascherson - Leafy Goosefoot**

[*Morocarpus foliosus* Moench]

An annual herb to 60 cm tall, with stems either erect or spreading. Leaves with 0.5-6.5 cm stalks, triangular to oblong, apex acute to acuminate, base cuneate, truncate or almost hastate, margins wavy or dentate, glabrous, 2-8 cm long and 1-3.5 cm wide. Inflorescence consisting of spikes with 3-8 mm diameter

glomerules, at intervals on the stem, turning red and resembling small strawberries, with leaf-like bracts throughout the spike. Flowers maturing from base to apex. Sepals 3 or 4, partly fused at base, with obovate lobes and a rounded apex. Stamens usually 1. Fruits horizontal, ovoid, smooth, dark reddish brown achenes. Seeds dark red-brown and 1-1.2 mm diameter. July-September. An introduced but uncommon weed in the grasslands of Alberta.

8. ***Chenopodium fremontii*** **S. Wats. - Fremont's Goosefoot**

[*C.f.* var. *pringlei* (Standl.) Aellen]

An annual with rather slender, erect, mealy stems, ranging from 10 to 80 cm tall, usually with longitudinal dark green lines. Leaves with 0.4-2.5 cm stalks, broadly triangular, sometimes ovate to elliptic, apex rounded to obtuse, base truncate or cuneate, margins entire or with a pair of basal lobes, farinose, 1-5 cm long and 1-4 cm wide. Inflorescence consisting of open, interrupted, spikes of small glomerules. Sepals 5, not fused, with ovate lobes, somewhat farinose and with an obtuse apex, covering the fruit at maturity. Fruits horizontal, ovoid, warty to smooth utricles. Seeds reddish brown to black, smooth and 1-1.3 mm in diameter. July-September. Native and common in moist areas among bushes and bluffs, mainly in southern Alberta and Saskatchewan.

9. ***Chenopodium glaucum*** **L. var. *salinum* (Standl.) B. Boivin - Saline or Oak-leaf Goosefoot**

[*C. g.* L. ssp. *s.* (Standl.) Aellen; *C. g.* var. *pulchrum* Aellen; *C. s.* Standl.]

An erect to prostrate plant, 10-40 cm tall with a rather fleshy, often reddish stem. Leaves with stalks to 1 cm, lanceolate to oval or oblong, sinuately toothed or lobed, resembling small oak leaves, farinose and whitish underneath, 0.5-4 cm long, 0.3-1.5 cm wide. Inflorescence consisting of glomerules in terminal or lateral spikes subtended by leaf-like bracts. Sepals 3 or 4, not fused, with obovate to oblong lobes that cover the fruit at maturity. Fruits horizontal and occasionally vertical, ovoid, smooth utricles. Seeds ovoid to round, dull reddish brown, rugose-punctate and 0.6-1.1 mm in diameter. August-October. Native and common in moist, saline locations or roadsides; throughout prairies and parklands of all three prairie provinces.

10. ***Chenopodium hians*** **Standl. - Hian's or Gaping Goosefoot**

[*C. incognitum* auct. p.p. non Wahl]

An erect annual, 10-45 cm tall, simple or with a few copiously and coarsely farinose branches. Leaves with 0.2-0.7 cm stalks, elliptic-oblong or narrowly lanceolate, at least the lower leaves 3-veined, apex acute to rounded, base cuneate, margins entire, green and glabrous above, densely and coarsely white farinose beneath, 1.0-2.5 cm long and 0.3-0.6 cm wide, petioles stout and up to half as long as blade. Inflorescence consisting of dense clusters in lateral spikes or narrow panicles. Sepals 5, not fused, with elliptic, oblong or narrowly ovate lobes that are slightly keeled, densely farinose and with a rounded apex, spreading from the fruit at maturity. Fruits horizontal achenes with small warts. Seeds lens-shaped, black, wrinkled and 1-1.4 mm in diameter. July-September. Native and rare in dry, sandy grasslands of southwest Saskatchewan.

11. ***Chenopodium incanum*** **(S. Wats.) A. Heller var. *incanum* - Mealy Goosefoot**

[C. *fremontii* S. Wats. var. *i.* S. Wats.]

An erect to spreading, densely branched annual, farinose, ranging from 6 to 15 cm tall. Leaves with stalks to 1 cm, ovate to triangular, apex acute,

base cuneate to nearly truncate, margins toothed and usually with a pair of basal teeth, farinose, 1-1.5 cm long and 0.5-1.6 cm wide. Inflorescence glomerules crowded in terminal and lateral panicles. Sepals 5, not fused, with ovate lobes, somewhat farinose and with an acute to obtuse apex, covering the fruit at maturity. Fruits horizontal, ovoid, smooth utricles. Seeds black and wrinkled, with a narrow rim and 0.9-1.1 mm in diameter. July-August. Native and uncommon or rare in sandy soils and hillsides in southeast Alberta and southwest Saskatchewan.

12. ***Chenopodium leptophyllum*** **(Moq.-Tan) Nutt. *ex* S. Wats. - Narrowleaf Goosefoot**

[*C. album* L. var. *l.* Moq.]

An erect annual, 10-40 cm tall, usually branching from the base with a somewhat farinose stem. Leaves with stalks to 0.5 cm, the blades linear, 1-veined, 0.7-2.6 cm long, 0.1-0.3 cm wide, somewhat fleshy, base cuneate, margins entire, apex obtuse, farinose above and densely farinose below. Inflorescence consists of dense glomerules in terminal and axillary panicles. Sepals 5, rarely 4, not fused, with lanceolate to elliptic lobes that are strongly keeled, densely farinose and with an obtuse to rounded apex, covering the fruit at maturity. Fruits horizontal, ovoid, smooth achenes. Seeds black, finely wrinkled and 0.9-1.1 mm in diameter. July-September. Native and rare in sand dunes and sandy disturbed grasslands in all three prairie provinces.

13. ***Chenopodium murale*** **L. - Sowbane or Nettle-leaved Goosefoot**

An erect, branched, glabrous annual to 60 cm high. Leaves with 1-2.5 cm stalks, triangular, ovate or rhombic, apex acute to acuminate, base cuneate to rounded, margins irregularly toothed or lobed, mature leaves glabrous, 0.8-4 cm long and 0.4-3 cm wide. Inflorescence glomerules in terminal and lateral panicles that lack bracts. Sepals 5, not fused, with ovate lobes that cover the fruit at maturity. Fruits horizontal, depressed ovoid, warty or smooth achenes. Seeds lens-shaped, round, black, smooth to wrinkled and 1-1.5 mm in diameter. August-October. An introduced but uncommon weed found in southern Alberta and Saskatchewan.

14. ***Chenopodium polyspermum*** **L. var. *acutifolium* Smith - Many Seeded Goosefoot**

[*C. acutifolium* Smith]

An erect, branched, glabrous annual to 1-m high. Leaves with stalks to 1.7 cm, ovate-elliptic or oblong, apex obtuse to rounded, base rounded to cuneate, entire or with a slight tooth above the base, glabrous, becoming red at maturity, 1.5-4 cm long and 0.4-2.5 cm wide. Inflorescence sparse with many axillary cymes. Sepals 5, with oblong to elliptic lobes that do not cover the fruit at maturity. Fruits horizontal, depressed ovoid, smooth utricles. Seeds brown-black, dull and 0.8-1.3 mm in diameter. June-July. An introduced but uncommon weed in east-central Saskatchewan.

15. ***Chenopodium pratericola*** **Rydb. - Desert Goosefoot**

[*C. albescens* Small; *C. desiccatum* auct. non A. Nels.; *C. d.* A. Nels. var. *leptophylloides* (Murr) Wahl; *C. p.* var. *l.* (Murr) Aellen; *C. leptophyllum* auct. non (Moq.) Nutt.]

An erect annual, 20-80 cm tall, simple or with a few branches above and farinose. Leaves with 0.4–1 cm stalks, linear to narrowly lanceolate or oblong-elliptic, at least the lower leaves with 3 veins, apex acute, base cuneate, margins entire, often with a pair of lobes or teeth near the base, somewhat fleshy, sparsely to densely farinose, 1.5-4.2 cm long and 0.4-1 cm

wide. Inflorescence consisting of axillary and terminal panicles. Sepals 5, rarely 4, not fused, with oblong to ovate lobes that are strongly keeled, densely farinose and with an obtuse, rounded or notched apex, spreading from the fruit at maturity. Fruits horizontal, ovoid, smooth utricles. Seeds round, black, wrinkled and 0.9-1.3 mm in diameter. July-August. A common native plant occurring on dry, sandy soils, slough margins and alkaline areas in prairies and parklands.

16. ***Chenopodium rubrum*** L. - **Red Goosefoot or Coast-blight**

[*C. humile* Hook.; *C. rubrum* L. ssp. *h.* (Hook.) Aellen]

An erect or prostrate plant to 75 cm high, with many ascending, glabrous branches. Leaves with stalks to 0.5 cm, triangular to rhombic, apex obtuse to acute, base cuneate, coarsely toothed or entire, glabrous, thick, dark green but usually blackening upon drying, 1-9 cm long and 1-6 cm wide. Glomerules 2-5 mm in diameter in leafy axillary spikes. Sepals 3 or 4, fused only at the base, with lanceolate to elliptic lobes that cover the fruit at maturity. Fruits vertical and occasionally horizontal, ovoid utricles with reticulate-punctate surfaces. Seeds, ovoid, smooth, dull reddish brown when ripe and 0.6-1.0 mm in diameter. August to October. A common native plant in saline, moist soil around sloughs and lakes, throughout the prairie provinces.

Two varieties are found in the prairies and these can be distinguished by using the following key:

1a. Stems erect or ascending; leaf margins deeply toothed; vertical seeds 0.6-0.8 mm wide.....var. *rubrum* L.

1b. Stems prostrate or spreading; leaf margins entire or shallowly toothed; vertical seeds 0.8-1 mm wide.....var. *humile* (Hook.) S. Wats.

17. ***Chenopodium simplex*** **(Torr.) Raf. - Maple-leaf or Big-seed Goosefoot**

[*C. gigantospermum* Aellen; *C. hybridum* auct. non L.; *C. h.* ssp. *g.* (Aellen) Hulten; *C. h.* var. *g.* (Aellen) Rouleau; *C. h.* var. *simplex* Torr.]

An erect, branched, glabrous annual, (30-) 50-120 cm high. Leaves with stalks to 0.5 cm, ovate to triangular, apex acute, base cordate to truncate, usually wavy or with 2-4 large sharp-pointed lobes on either margin, glabrous, 3.5-15 cm long and 2-9 cm wide. Inflorescence of individually arranged flowers in interrupted panicles. Sepals 5, fused at the base, with lanceolate to ovate lobes that do not cover the fruit at maturity. Fruits horizontal, depressed ovoid, smooth achenes. Seeds lens-shaped, black and 1.3-1.9 mm in diameter. July-October. A fairly common native plant found in shady wooded places or disturbed areas throughout the prairie provinces.

18. ***Chenopodium strictum*** **Roth - Late-flowering Goosefoot or Upright Lamb's-Quarters**

[*C. album* L. var. *striatum* (Kras.) Kartesz; *C. glaucophyllum* Aellen; *C. strictum* Roth ssp. *g.* (Aellen) Aellen; *C. s.* Roth var. *g.* (Aellen) Wahl]

An erect, branched, annual, 45-100 cm tall, glabrous to sparsely farinose. Leaves sessile, ovate-lanceolate to oblong-ovate, apex obtuse, base cuneate, margins finely toothed, farinose, 1.7-3.6 cm long and 1-3 cm wide. Inflorescence glomerules rounded and in terminal spikes. Sepals 5, not fused, farinose, the lobes ovate, slightly keeled and rounded at the apex, not covering the fruit at maturity. Fruits horizontal, depressed, ovoid, smooth achenes. Seeds black, smooth, oval in outline and 0.9-1.5 mm in diameter. August to October. An

introduced but uncommon weed in the southern grasslands of Saskatchewan and Manitoba.

19. ***Chenopodium subglabrum* (S. Wats.) A. Nels. - Smooth Goosefoot**
[*C. leptophyllum* auct. non (Moq.) Nutt. *ex* S. Wats.; *C. l.* (Moq.-Tan.) Nutt. *ex* S. Wats. var. *s.* S. Wats.]

An erect, branched annual, 10-55 cm high. Leaves with stalks to 1 cm, linear, 1-veined, apex acute to acuminate, base cuneate, margins entire, somewhat fleshy, glabrous or very sparsely farinose, 1-3 cm, long and 0.1-0.2 cm wide. Inflorescence consists of small widely-spaced clusters in terminal and axillary panicles. Sepals 5, partly fused at base, sparsely farinose with ovate lobes that are obtuse or rounded at the apex, sparsely farinose and largely cover the fruit at maturity. Fruits horizontal, smooth achenes. Seeds lens-shaped with a narrow rim black, smooth, shiny and 1.3-1.6 mm in diameter. July-September. Native and rare on sand dunes and sand plains in Alberta, Saskatchewan and Manitoba.

20. ***Chenopodium watsonii* A. Nels. - Watson's or Dakota Stinking Goosefoot**
[*C. dacoticum* Standl.; *C. glabrescens* (Aellen) Wahl.; *C. olidum* S. Wats.]

An annual 2-15 cm tall, with erect, ascending or decumbent, farinose, angular stems that are much branched. Leaves with 0.4–1.4 cm stalks, ovate, rounded triangular or rhombic, apex rounded to obtuse or acute, base rounded, broadly cuneate or nearly truncate, margins entire or with a pair of basal teeth, densely farinose, with a fishy scent when bruised, 1-2.6 cm long and 0.5-2.9 cm wide. Inflorescence consists of glomerules in paniculate spikes. Sepals 5, partly fused at the base, keeled, farinose and ovate with acute to obtuse apices that cover the fruit at maturity. Fruits horizontal achenes that are whitened and honeycombed. Seeds whitened and coarsely honeycombed, subglobose and 0.9-1.3 mm in diameter. July-September. Native and rare in badlands, river valleys, and disturbed native prairie in Alberta and Saskatchewan.

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BEACHCOMBER

A turnstone overturns beach stones
with crowbar bill his tool to mine
for food. Crustacea he eats
and mollusks small steeped well in brine,
then waddles on on orange legs
along the pebble-strewn shoreline.

- Victor C. Friesen

BIODIVERSITY AND ADULT EMERGENCE PERIODS OF MAYFLIES (EPHEMEROPTERA) INHABITING CANDLE LAKE, SK

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Introduction

Over two-thirds of Saskatchewan's freshwater is found in lakes and rivers of the boreal forest.[6] These habitats not only provide a reservoir of freshwater but also offer economic opportunities for fishing, trapping, hunting, recreation, and ecotourism.[6] However, such activities can adversely affect these habitats through excessive use and pollution. Watershed usages such as logging, mining, and agriculture, and the effects of climate change can also affect the physical, chemical and biological integrity of these boreal aquatic ecosystems.[14] Detailed baseline data on the biodiversity, biology and ecology of aquatic animals inhabiting lakes and rivers provide an understanding of how these systems function and facilitate accurate monitoring procedures.[13]

Mayflies (Ephemeroptera) form a significant part of Saskatchewan's aquatic insect diversity.[11,16] Of the 675 mayfly species reported in North America, 106 are known from Saskatchewan.[16,17] As larvae, mayflies form important basic links in aquatic food webs by feeding on algae and decaying organic material.[5,10,12] The larvae and adults are also important prey for fish, waterfowl, passerine birds, bats and predatory insects.[5,16] Many mayfly species are intolerant to pollutants, low oxygen levels and habitat alterations, and for these reasons are often used in environmental impact assessments and monitoring programs.[7,12,13,16] Unfortunately, biological information regarding most Saskatchewan mayflies is lacking.[16] This paper reports on mayflies collected from Candle Lake, Saskatchewan during research conducted in 2001 and 2002.

Study Area

Candle Lake is located in central Saskatchewan on the southern edge of the boreal forest (Figure 1). The lake covers an area of 13,252 hectares and has a maximum depth of 18.5 meters. The resort village of Candle Lake, associated subdivisions, cabin developments, marinas and a provincial park are found adjacent to the lake. A large number of people visit the lake for a variety of year round recreational activities. Land use in the Candle Lake watershed includes

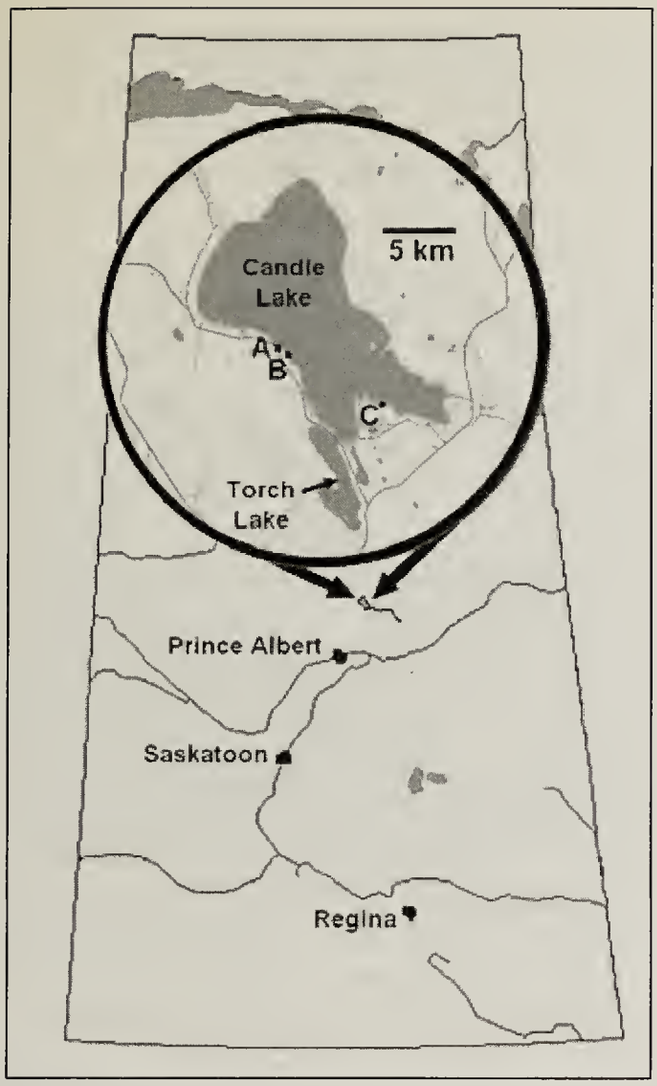

Figure 1: Map of Saskatchewan indicating location of Candle Lake. Inset indicates detail of the Candle Lake area and the three primary sampling locations.

logging, agricultural crops, livestock production and, recently, mining exploration.

Three primary study sites (A, B, and C in Figure 1) that typified the shoreline habitats present in Candle Lake were selected.

Site A: Onechassa (53° 48' 20" N, 105° 20' 31" W) is characterized by a lack of emergent and submerged vegetation. The substrate is small to large rocks embedded in sandy silt. The unprotected shoreline consists of wave-washed large rocks.

Site B: Sandy Bay Campground (53° 48' 03" N, 105° 19' 43" W) is a small bay 200 m northwest of the provincial campground and beach. The substrate consists of areas of stable or shifting fine sand and silt with embedded rocks. An extensive bed of bulrushes (*Scirpus validus*) protects the shoreline from severe wave action. Clumps of cattails (*Typha latifolia*) and common reed grass (*Phragmites communis*) occur along the shoreline. Beds of stonewort (*Chara sp.*) develop during the summer. Submerged logs and fallen trees provide additional microhabitats. The shoreline ranges from rocky to sandy.

Site C: Northview Subdivision (53° 46' 16" N, 105° 13' 46" W) has three general habitat areas; wetland, emergent vegetation and open water (Figure 2).

The wetland lies between the lakeshore and a stabilized sand bar. It is covered by dense aquatic vegetation consisting of bulrushes, cattails, sedges (*Carex spp.*), horsetail (*Equisetum spp.*) bur-reed (*Sparganium sp.*), sweet flag (*Acorus calamus*), arrowhead (*Sagittaria cuneata*) water-plantain (*Alisma sp.*), pondweeds (*Potamogeton spp.*), spike-rush (*Eleocharis spp.*) smartweed (*Polygonum amphibium*), mare's-tail (*Hippuris vulgaris*), buttercups (*Ranunculus spp.*), mint (*Mentha arvensis*), hornwort (*Ceratophyllum demersum*), water-milfoil (*Myriophyllum sp.*), bladderwort (*Utricularia vulgaris*), and other species. This vegetation forms a thick mat of entangled roots, rhizomes and decaying vegetation that floats approximately 20 cm above the lake bottom. During the spring and early summer this area was usually covered by water. At lower water levels, surface water disappears from some areas but the vegetation mat remains saturated. During windy conditions, lake swells can raise the water level in the wetland.

Adjacent to the wetland is an area of thick emergent vegetation consisting primarily of sedges, cattails, bulrushes and horsetail. The substrate is predominantly sandy silt with some decaying vegetation and a few embedded rocks and submerged logs.

The remainder of the site is open water with sparse bulrush cover. The substrate consists of relatively stable, sand and silt with embedded rocks. The shoreline ranges from rocky to stabilized sandy silt. Wave action can be severe, causing erosion to exposed shorelines.

Methods

Qualitative sampling was conducted at approximately four-week intervals at each site during the ice-free season of 2001. Collections were made by sweeping a 20 cm diameter sieve or 30 cm D-framed aquatic dip net with 0.5 mm mesh openings through the water column, the emergent and submersed vegetation and along the bottom substrate. A rectangular 20 cm by 10 cm aquarium net with 0.1 mm mesh openings was used to sweep the water surface to collect exuviae (cast skins) and emerging adults. Aerial sweep net samples were taken along the shore at each site to collect adults. Aquatic samples were partially sorted in the field and preserved in 100% alcohol. Aerial samples were preserved in 75% alcohol in the field. In the lab, the material was sorted, identified and preserved in labeled vials with 75% alcohol.

In 2002, the lake sediment was sampled for mayflies using a 6-inch (231 cm^2) Ekman grab. The lake was divided into three depth ranges 0 to 5 m, 5 to 10 m, and >10 m. On June 22, July 19 and August 22, three Ekman samples were taken in each of the three depth ranges and preserved in 100% alcohol. In the lab, the samples were sieved through a 0.5 mm sieve and larvae were sorted from the residue, identified, enumerated and preserved in labeled vials in 75% alcohol. The data were combined for the three sampling dates.

To determine the timing and densities of emerging adults (# emerging/m^2/day) five, 0.49 m^2, floating emergence traps (Figure 3) were randomly placed in each habitat type at Site C (Figure 2).[4,8] Water depth was measured at each trap. Traps were operated continuously from June 3 to September 30. Collections were made between 0900h and 1100h on a two-day, two-day, three-day schedule except for July 2 to July 3 when collections were made on July 2 after four days and July 3 after one day. Samples were preserved in 75% alcohol. Specimens were sorted, identified, sexed, enumerated and placed in labeled vials with 75% alcohol.

Results

Twelve species of mayfly belonging to six families were collected from Candle Lake during the study (Table 1).

Eleven species were collected by qualitative sampling methods. Eight species were collected from Site A, nine from Site B and six from Site C. Four species, *Caenis latipennis*, *Stenonema femoratum*, *Tricorythodes minutus*, and *Leptophlebia nebulosa* were collected at all sites. *Baetis sp.* and *Stenacron interpunctatum* were collected only from site A and *L. cupida* was collected only from Site B.

Four species were collected in the Ekman samples (Table 1). *Callibaetis ferrugineus, Caenis latipennis* and *Ephemera simulans* were collected only from the 0-5 m zone. *Hexagenia limbata* preferred the 5-10 m zone and

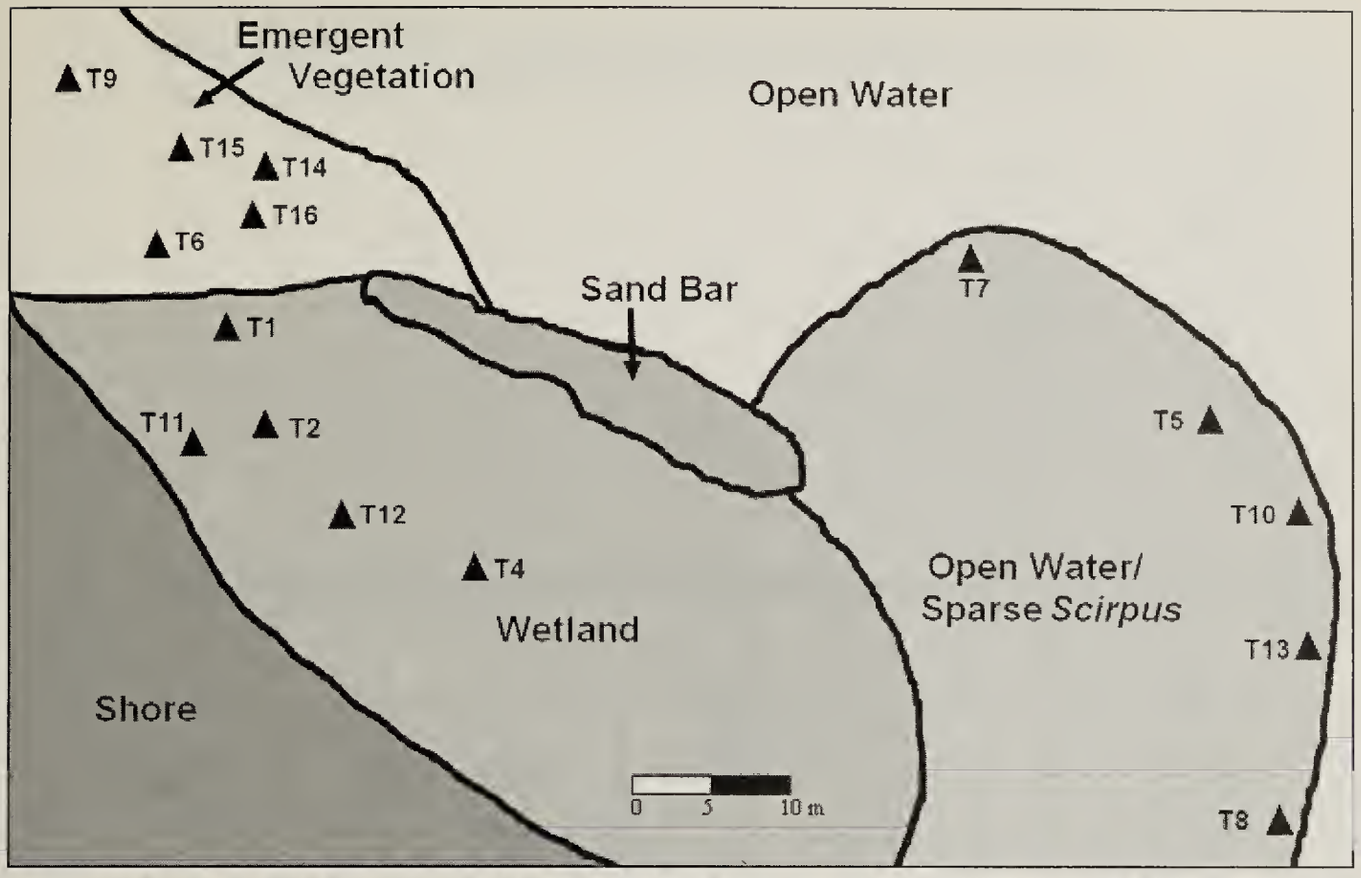

Figure 2: Detailed map of Site C indicating vegetation zones and emergence trap (T#) locations.

Figure 3: Floating emergence trap used at Site C.

was the only species collected below 10 m.

The emergence traps placed at Site C collected 2165 mayflies belonging to eight species (Table 1) including *Procloeon quaesitum*, which had not been collected using other methods. Adult mayfly emergence occurred from June 3 to September 12, with most species emerging during July and August (Figure 4).

Average water depths at the emergence traps were 8 cm (range 0.64 to 12.9 cm) for the wetland habitat, 20.4 cm (range 13.5 to 25.6 cm) for the emergent vegetation habitat and 31.2 (range 23.9 to 35.9 cm) for the open water habitat.

Leptophlebia nebulosa (Figure 5) accounted for 97.9% of the mayflies collected in the emergence traps (Table 1). Almost three-quarters, 74.5%, of the adults of *L. nebulosa* were collected in the emergent vegetation zone. The wetland traps accounted for 25.4% of the total and the open water traps collected less than 0.1%. These counts translate into an average yearly production of 644.5 adults/m^2 in the emergent vegetation, 219.6 adults/m^2

Mayflies Collected	Species Collected At Qualitative Sample Sites	Counts of larvae collected in Ekman grabs (9 grabs/zone)			Counts of adults collected in emergence traps at Site C (5 traps/habitat)			
		0-5 m	5-10 m	>10 m	Wetland	Emergent Vegetation	Open Water	Total
Baetidae								
Baetis sp.	A						8	8
Callibaetis ferrugineus (Walsh)	B,C	3			3	7		10
Procloeon pennulatum Eaton	A,B							
Procloeon quaesitum (McDunnough)						2	5	7
Caenidae								
Caenis latipennis Banks	A,B,C	4				2	2	4
Ephemeridae								
Ephemera simulans Walker	B,C	5						
Hexagenia limbata Serville	A,B		15	1	1			1
Heptageniidae								
Stenacron interpunctatum (Walker)	A							
Stenonema femoratum (Say)	A,B,C							
Leptohyphidae								
Tricorythodes minutus Traver	A,B,C				1	4	10	15
Leptophlebiidae								
Leptophlebia cupida (Say)	B					1		1
Leptophlebia nebulosa (Walker)	A,B,C				538	1579	2	2119

Table 1: Site occurrences, Ekman grab counts and adult emergence counts of mayflies collected in Candle Lake.

in the wetland zone and only 0.8 adults/m^2 in the open water zone.

Leptophlebia nebulosa was the earliest mayfly to emerge in the traps (Figure 4). It was first collected in June 5 samples and the last specimens were collected by July 12 (Figure 6). The largest emergence, 126.5 adults/m^2/day, was recorded on June 21. The sex ratio for *L. nebulosa* was 1.42:1 (1242 males: 877 females). There was no observed trend of either sex emerging earlier than the other.

Discussion

All the mayflies recorded from Candle Lake have previously been reported from Saskatchewan.[3,16] Three species, *Tricorythodes minutus*,

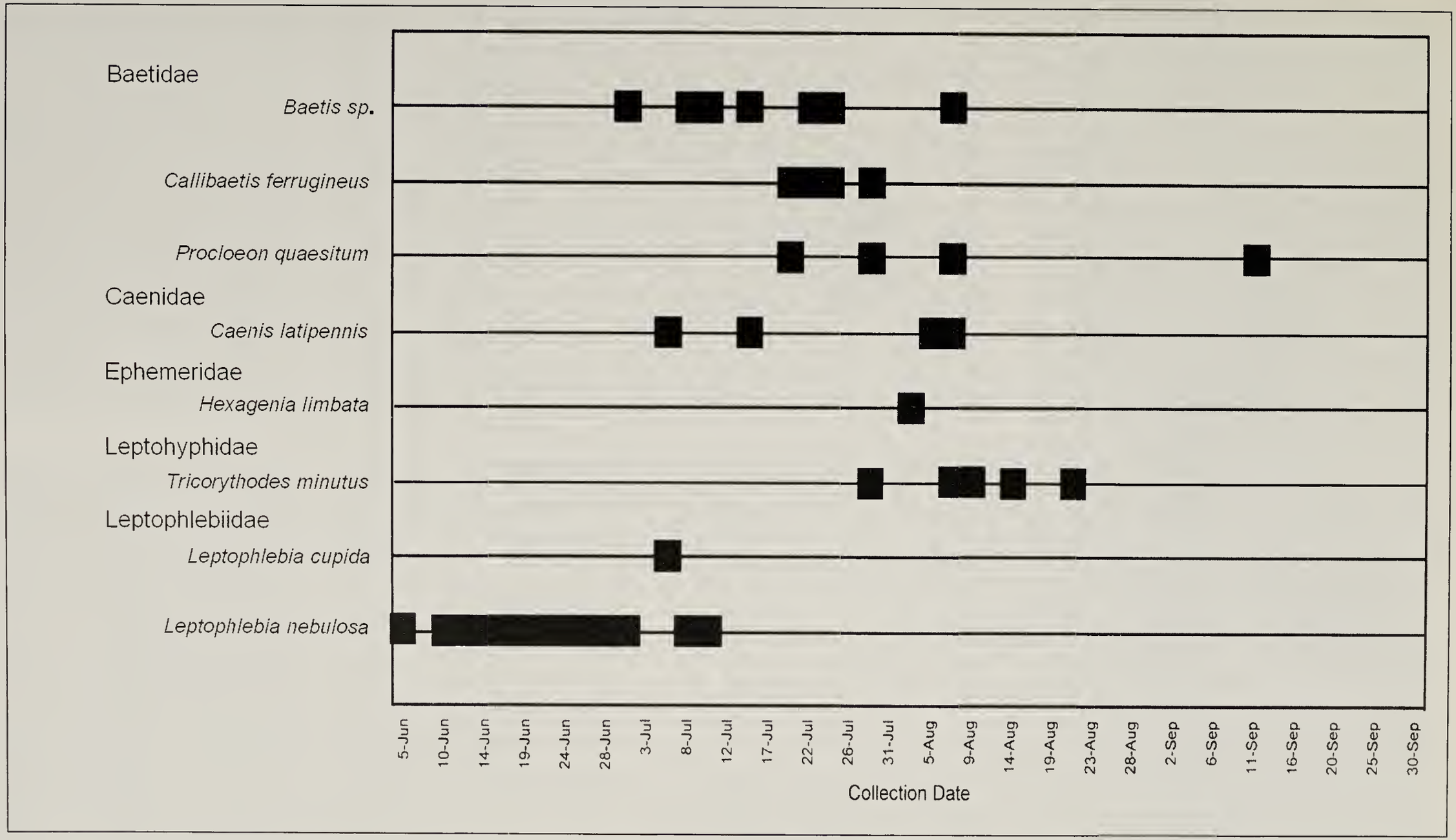

Figure 4: Emergence periods of adult mayflies inhabiting Candle Lake as determined by emergence trap collections at Site C.

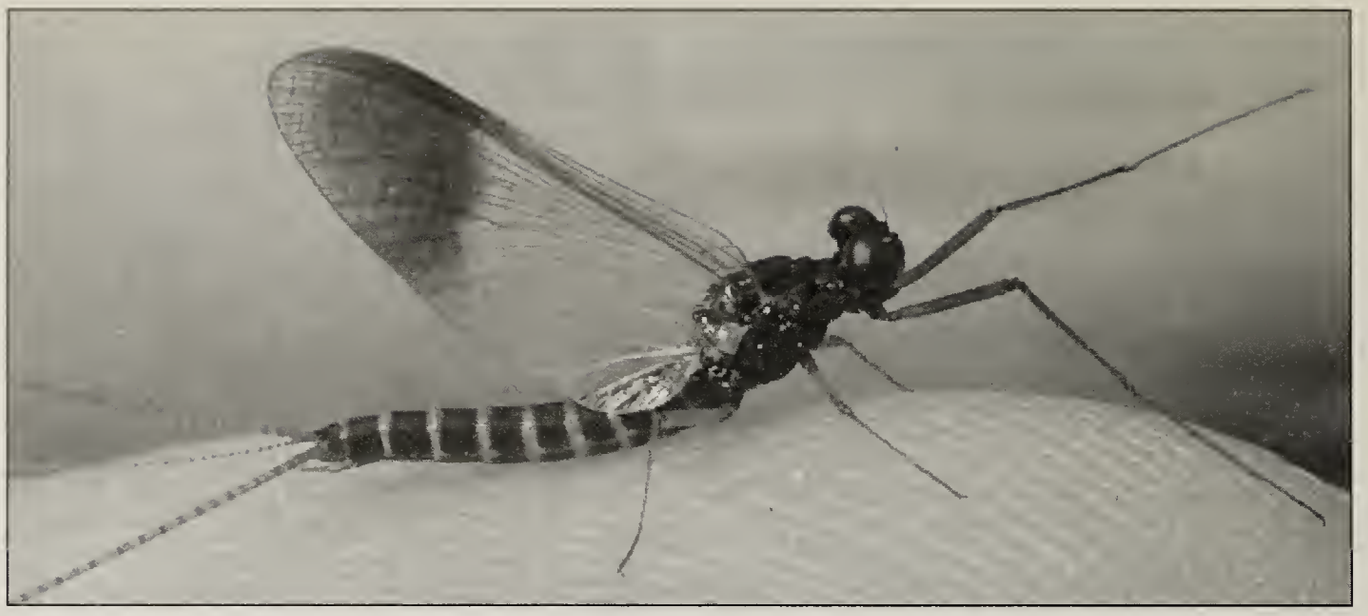

Figure 5: Adult male of Leptophlebia nebulosa *sitting on fingertip. (Note enlarged eyes indicative of males.)* *D. Parker*

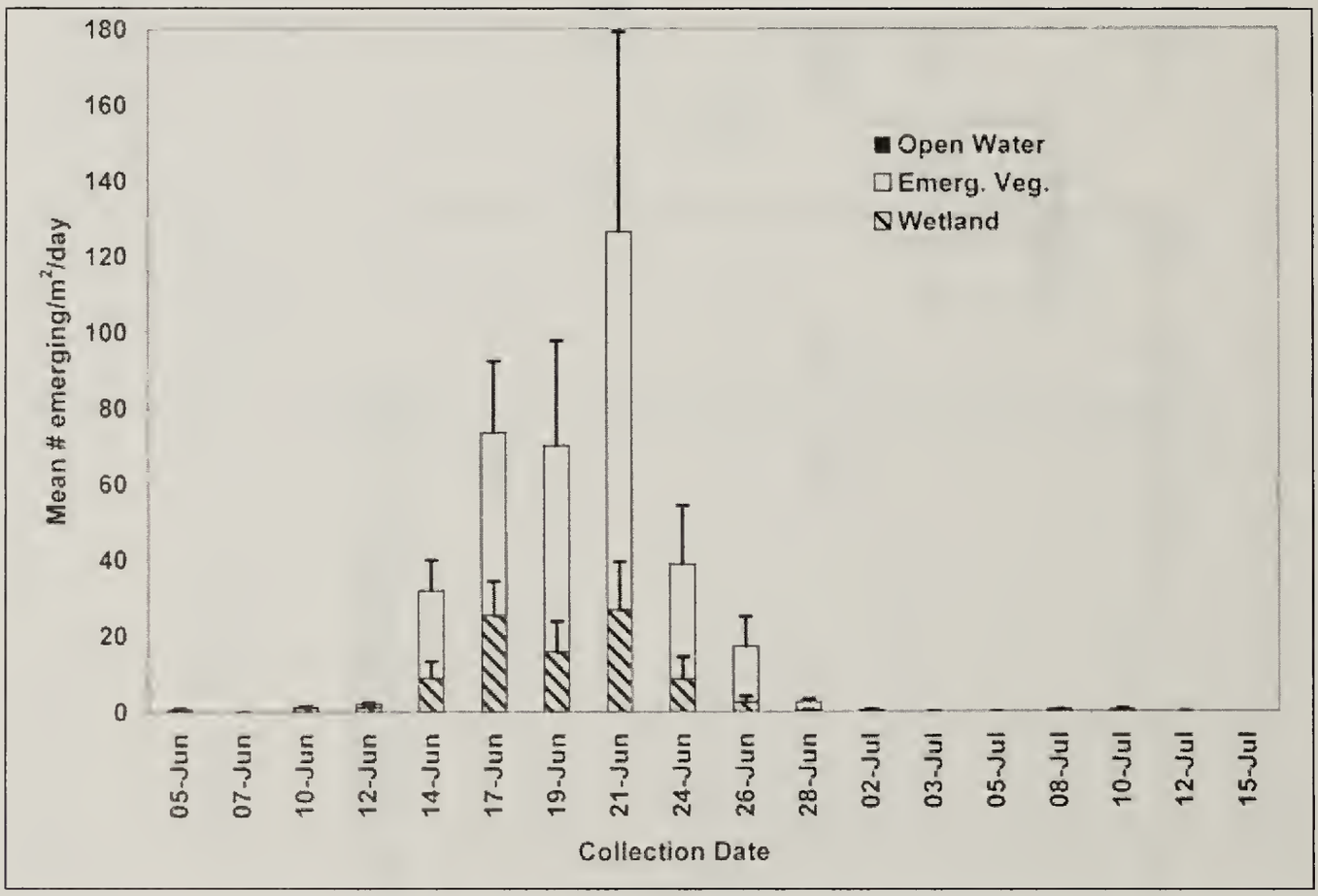

Figure 6: Adult emergence patterns of L. nebulosa *as determined by emergence trap sampling at Site C. (Error bar +1 se)*

Stenonema femoratum, and *Stenacron interpunctatum* are more typical of rivers and streams than of lakes.[16] The presence of the bottom- sprawling *T. minutus* is unexpected, as it has previously been reported from only one other lake.[3] *S. femoratum* and *S. interpunctatum* were mostly found associated with rocky wave-washed shorelines that provide microhabitats with enough wave-created current for them to survive.

Shallow water (littoral) zones are critical lake habitats.[15,18] In lakes, the most abundant and diverse mayfly communities are associated with these habitats.[1] This was the case in Candle Lake. The vegetation, fallen logs, and rocks subdivided the shallow water

along the shore into numerous microhabitat types that could be exploited by mayfly larvae.

Hexagenia limbata was the only mayfly found in the deeper areas of the lake. Larvae of this species dig U-shaped tubes in soft substrates. The larva undulates its body and gills to create a water current through the tube to ventilate its gills and to filter feed. It has been recorded in low numbers to depths of 18 m and dissolved oxygen levels down to 1.0 ppm, which is unusual for mayflies. [5]

Leptophlebia nebulosa emerged from early June to mid-July, with the highest number of adults collected in mid-June. Absence of further emergence suggests it has only one adult emergence period each year (univoltine life cycle) in Candle Lake. A similar emergence pattern was recorded in a Michigan lake.[9] The life cycle exhibited by *L. nebulosa* is a Uw type (seasonal univoltine winter cycle: the population overwinters in the larval stage).[2] Unlike some species of mayflies that emerge directly from the water surface, mature larvae of *L. nebulosa* crawl out of the water onto an aerial substrate such as a plant stem or stick before the adult emerges. Larvae prefer vegetated habitats rather than sandy shores or wave-washed rocky shorelines.[9] In the spring, the larvae migrate very close to shore prior to emergence.[9] This preference for vegetated habitats was confirmed in Candle Lake by the large number of adults collected from the emergent vegetation and wetland traps compared to the sparsely vegetated open water area.

Conclusions

Candle Lake has a diversity of mayflies due to its variety of shallow water habitats, including wave-washed, rocky shallows that enable a number of species more typical of running water to successfully inhabit the lake. The mayfly fauna, except for *Hexagenia limbata*, was restricted to the shallower areas of the lake.

The numerically dominant mayfly, *Leptophlebia nebulosa*, has a univoltine life cycle with peak adult emergence occurring in mid-June. Its preference for shallow water habitats with emergent vegetation may make this species vulnerable to future developments that reduce the emergent vegetation in the lake. For this reason, it may be a good species for monitoring the effects of human activity on the lake. Larvae of *L. nebulosa* are likely a very important early spring food source for fish, and the adults for waterfowl and passerine birds. If human developments reduce populations of *L. nebulosa* through loss of habitat, this would likely reduce the food supply for many fish and birds at a critical time in their life cycles.

Acknowledgments

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According to Frank Todd's *10,001 Titillating Tidbits of Avian Trivia*, the Laysan Duck is the bird that declined to the lowest population level and subsequently recovered. "In 1930, the entire population was reduced to a single gravid female. An experienced biologist spent 16 days on the tiny island of Laysan, finding but a single pair of the ducks and a nest in which all the eggs were punctured by a Bristle-thighed Curlew. The drake subsequently disappeared, but the female retained sufficient semen in her oviduct to lay a fertile replacement clutch of eggs. Thus, the species owes it existence to that single persistent female. The endemic duck is well-established in captivity, and the wild population on Laysan Island was about 500 birds in the mid-1980s."

EARLY SIGHTING OF A RARE BUTTERFLY, MORMON METALMARK, IN GRASSLANDS NATIONAL PARK, SK

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The Mormon Metalmark, *Apodemia mormo* (C. & R. Felder), is a medium-sized butterfly of arid regions that is named for the white metallic markings on its wings (Figure 1, see inside back cover, top).[4] It belongs to the tropical family Riodinidae and is this family's only Canadian representative.[3] In Canada, there are two populations of Mormon Metalmark: the Southern Mountain Population in the Similkameen River Valley of British Columbia and the Prairie Population in and around Grasslands National Park (GNP) of south-western Saskatchewan.[4] The Saskatchewan population was designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Threatened in 2002.[1] For this reason, the Mormon Metalmark has become a focal species for Species at Risk monitoring in Grasslands National Park.

The Mormon Metalmark is thus far known to occur on hillsides with barren clay or heavy clay soil where its host plant, the Branched Umbrella Plant, *Eriogonum pauciflorum,* (Figure 2) occurs.[4] Adult metalmarks require mature, robust Branched Umbrella Plants for oviposition, and flowering Branched Umbrella Plant and Rubber Rabbitbrush, *Ericameria nauseosa*, (Figure 3) for foraging.[4] Upon emergence, adults fly, forage and mate for 10 days; the adult flight period typically lasts until late August or early September.[4] Mormon Metalmark larvae

*Figure 2. Flowering Branched Umbrella Plant (*Eriogonum pauciflorum*) in GNP A. Henderson*

*Figure 3. Flowering Rubber Rabbitbrush (*Ericameria nauseosa*) in GNP A. Henderson*

require the branched umbrella plant's leaves for feeding and probably need its woody stems and underlying leaf litter for overwintering.

The Mormon Metalmark ranges from northern Mexico through the western United States to southern British Columbia and Saskatchewan[1] and adult emergence times vary throughout this range. Adult Mormon Metalmarks need nectar, and the metalmark flight period coincides with the flowering period of *E. pauciflorum*.[4] In British Columbia, adult metalmarks are typically in flight from mid-August to late September with peak activity during August.[2]

In the past, surveys for Mormon Metalmark in Saskatchewan have been conducted in mid- to late August. From August 13 to September 11, 2002, Ron Hooper of the Saskatchewan Royal Museum surveyed for Mormon Metalmark in and around GNP and identified 6 locations where adult Mormon Metalmark were observed in flight. In August of 2006, GNP staff surveyed the West Block of GNP and identified two new Mormon Metalmark locations. Recent observations suggest that metalmark surveys should begin earlier. On July 23, 2007, amidst ambient temperatures of 40.3°C, we visited the badlands of Grasslands National Park in search of Mormon Metalmark. Temperatures in GNP on that day reached a record-breaking high for the region. Much to our delight, we found an estimated 10 to 20 adult Mormon Metalmarks feeding and mating in a large, dense, flowering patch of their host plant, *Eriogonum pauciflorum*. This is the earliest recorded sighting for the Mormon Metalmark in Saskatchewan. Our observations suggest that metalmark surveys in southwestern Saskatchewan should coincide with *E. pauciflorum* flowering, which may begin in early to mid-July (A. Henderson, personal observation).

Saskatchewan's grasslands are home to an incredible diversity of insects. If you would like more information about the arthropods of Grasslands National Park, please contact Allison Henderson, Grasslands National Park Species at Risk Monitoring Technician.

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"Nothing is more humbling than to look with a strong magnifying glass at an insect so tiny that the naked eye sees only the barest speck and to discover that nevertheless it is sculpted and articulated and striped with the same care and imagination as a zebra. Apparently it does not occur to nature whether or not a creature is within our range of vision, and the suspicion arises that even the zebra was not designed for our benefit."
Rudolf Arnheim, psychologist and author (1904-2007)

EXTENDED RANGE AND FLIGHT PERIOD OF THE COMMON BUCKEYE BUTTERFLY IN SOUTHERN MANITOBA

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Introduction and Description

This article describes a recent series of Common Buckeye, (*Junonia coenia* Hübner), butterfly records in Manitoba. These comprise one specimen in 1994, three specimens in 2001, and three specimens plus at least seven individuals seen in 2007. Klassen et al. summarized previous records for the province as follows: nine specimens collected at six locations on 1 to 25 July between 1930 and 1941, plus a colony reported in Sandilands Provincial Forest in early August 1976.[7] One of the specimens, a worn female in the Royal Saskatchewan Museum (RSM), collected by J.B. Wallis at Husavik (often written Husavick), is dated 2 July 1910. Since this is one of the localities listed by Klassen et al., it is possible that "1930" is a transcription error.[7] Details of all recent records (1994 to 2007) are provided in Table 1, and localities for both recent

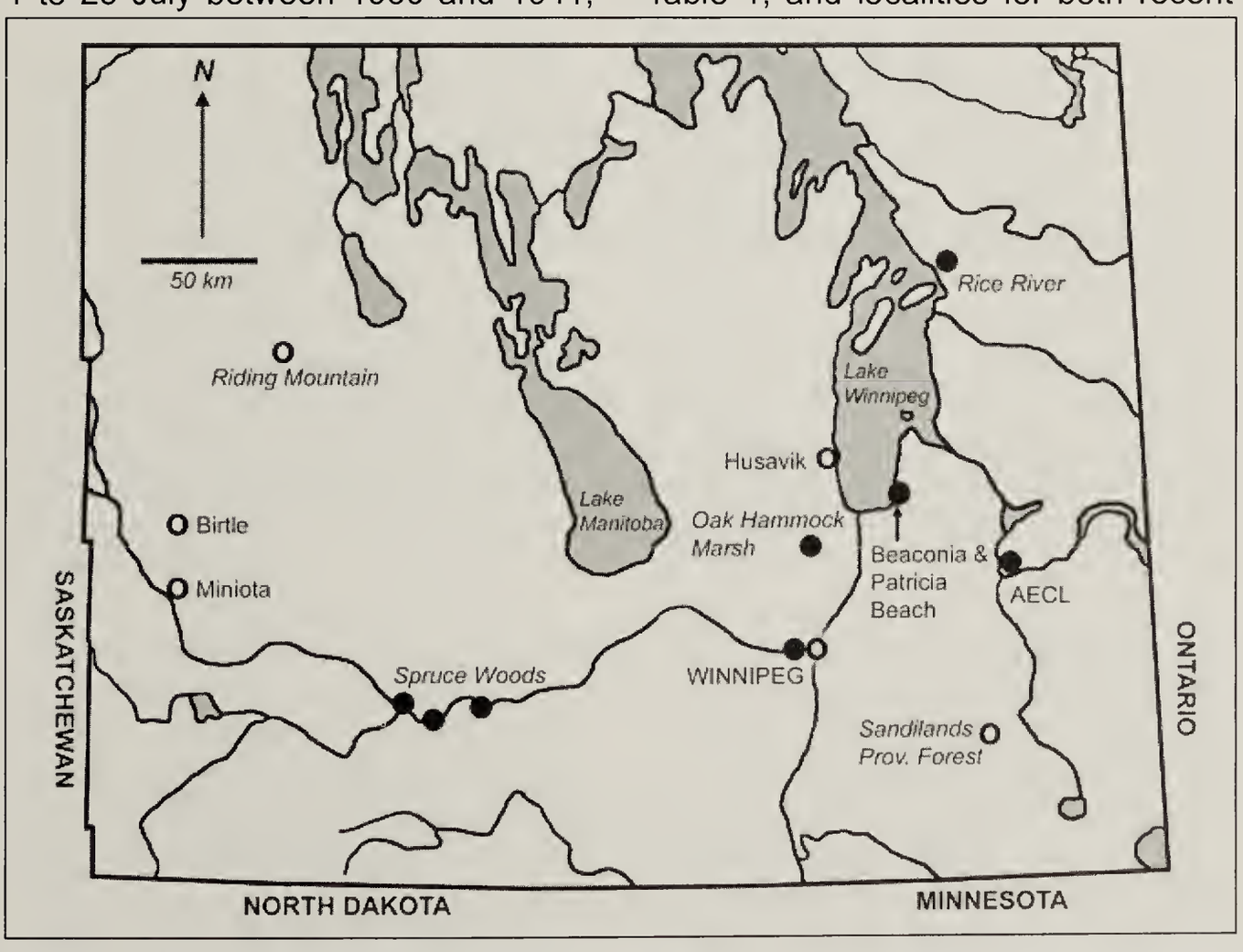

Figure 1. Map of Buckeye records for Manitoba. Open circles represent historic records (1910 to 1976); filled circles represent recent records (1994 to 2007).

TABLE 1 : Recent Manitoba Buckeye records

Date	Number	Record Type	Location	Latitude	Longitude	Observer
20 July 1994	1	specimen	Winnipeg	49º 52' 40"	97º 04' 35"	D.G. Delf
29 June 2001	1F	specimen	Rice River Road	51º 19' 57"	96º 22' 13"	R.Westwood
4 July 2001	1M	specimen	Rice River Road	51º 21' 50"	96º 23' 09"	R.Westwood
18 August 2001	1F	specimen	Rice River Road	51º 19' 57"	96º 22' 13"	R.Westwood
24 July 2007	1F	specimen	Spruce Woods – Shilo area	49º 40' 49"	99º 02' 14"	R.Westwood
25 July 2007	1M	specimen	Spruce Woods – Shilo area	49º 44' 16"	99º 37' 08"	R.Westwood
17 August 2007	1F	specimen	Spruce Woods – Shilo area	49º 38' 51"	99º 27' 21"	R.Westwood
23 August 2007	1	observation	Winnipeg	49º 52' 05"	97º 06' 53"	L. de March
15 September 2007	1	photograph	Beaconia beach	50º 26' 24"	96º 34' 55"	P. Taylor
16 September 2007	2	photograph	Oak Hammock Marsh *	50º 10' 57"	97º 09' 36"	L. de March
17 September 2007	1	observation	Patricia Beach	50º 25' 35"	96º 36' 29"	L. Klassen
17 September 2007	2	observation	Oak Hammock Marsh *	50º 10' 57"	97º 09' 36"	L. Klassen
3 October 2007	2	observation	AECL property w. of Pinawa †	50º 10' 30"	96º 03' 40"	P. Taylor

* The two Oak Hammock Marsh records may have involved repeat sightings of the same two individuals.

† Atomic Energy of Canada Limited (Whiteshell Laboratories).

and historic records are mapped in Figure 1.

The Common Buckeye (hereafter, Buckeye) is a medium-sized nymphalid butterfly, though with considerable geographic and generational variation in size, as well as sexual dimorphism. It resembles the Red Admiral in its silhouette, rapid flight, and territorial behaviour. The primary field mark in flight is a creamy-white patch toward the tip of each forewing. At rest with wings folded above the back, a leaf-like appearance is maintained (Figure 2, on inside back cover, middle). In a dorsal basking posture, however, the butterfly displays a rich pattern of peacock-like "eyes" and orange markings, as well as the bold, creamy patches noted above (Figure 3, on inside back cover, bottom).

Migration and Distribution

Opler and Krizek classify the Buckeye as an emigratory species, characterized by irregular northward expansions, usually during late summer.[11] These movements may represent either northward migratory behaviour or dispersal from areas with elevated populations. This is distinct from species such as the Monarch that perform well-defined two-way migrations. Some butterflies, for example the Red Admiral and Painted Lady, show northward movements in varying numbers in spring, with less frequently observed return flights.[9,10]

The Buckeye's core winter range is in the southern United States and northern Mexico.[11] The northward emigratory range extends through most of the lower 48 United States, except Montana, Washington and much of Idaho and Wyoming, to parts of southern Canada.[1,3,5,8,11] Records are sparse in many of the northern states, and most Canadian records are concentrated in southern Ontario and Quebec, northward to Manitoulin Island, Algonquin Park, and Quebec City.[3,8] In states adjoining Manitoba, recent distribution maps show records for 16 of 87 Minnesota counties and 6 of 53 North Dakota counties.[1] In northwestern Ontario there is an outlying record for Geraldton, east of Lake Nipigon.[3,8]

Ron Hooper, a long-time Saskatchewan entomologist and frequent contributor to this journal, noted some years ago that the Buckeye should be watched for in southeastern Saskatchewan as well as in southern Manitoba.[4] More recently he confirmed that there are still no definite records for Saskatchewan, though the RSM has a Buckeye wing donated by a resident of Bracken in southwestern Saskatchewan, and possibly found there (R. Hooper, letter to PT).

Food Plants and Habitat

Commonly cited larval food plants belong to the plantain and figwort families (*Plantaginaceae* and *Scrophulariaceae*): ribgrass or English plantain (*Plantago lanceolata*), snapdragon (*Antirrhinum* sp.) gerardia (*Gerardia* sp.), and toadflax (*Linaria* sp.).[1,5,7,11] Several of these plants are exotic to North America. As with many butterflies, preferred nectar sources for adults include various composites (*Asteraceae*) and dogbane (*Apocynum* sp.).[11]

Buckeyes generally prefer open areas with low vegetation and at least some areas of bare ground, e.g., roadsides, dry fields with dirt roads, open pine woods, beach dunes, and railroad tracks.[11] Royer mentions their occurrence on mown lawns and 'untended lawns when plantain growth is flourishing'.[12] Recent Manitoba records are consistent with these

descriptions. Observation sites along the Rice River Road in 2001 consisted of gravel roadside clearings in mixed boreal forest dominated by Black Spruce, Jack Pine, and Trembling Aspen. Buckeye specimens found in and near Spruce Woods Provincial Park in 2007 were frequenting open, mixed prairie sites containing numerous species of flowering herbs. The Beaconia and Patricia Beach sightings were on a sandy stretch of Lake Winnipeg shoreline. The Oak Hammock Marsh records were near an artesian spring adjoining restored prairie, and the butterflies settled mainly on bare ground. Those near Pinawa were in disturbed areas near a small sewage lagoon adjoining an industrial site in mixed boreal forest.

Flight Periods and Possible Origins

In southern Ontario, immigrant Buckeyes arrive in June, their progeny emerge in late July, and the flight period extends to early October, with a possible late brood emerging in September.[3] Some July specimens from older records in Manitoba show signs of wear, and they are possibly immigrant adults originating in the northern United States.

Based on wing appearance, the late June and early July 2001 specimens from the Rice River Road were freshly emerged. They had evidently either originated at the collection site or very recently arrived from sites close by. They may have been offspring of immigrant adults that could have laid eggs in May. It is unlikely that they represent a local resident population, given what is known of the species' distribution and habits.

The specimens collected in the Spruce Woods–Shilo region in 2007 where not particularly worn but certainly not freshly emerged; they may well have originated in the Dakotas. Twenty plots in this region were sampled twice a week from mid-June to late August, and it is unlikely that the species would have been overlooked, if present in any numbers, before the two late-July records.

One of the two individuals seen near Pinawa on 3 October 2007 was in immaculate condition, suggesting local emergence. The Beaconia, Oak Hammock Marsh, and Patricia Beach butterflies were seen during and immediately after a strong southerly wind on 15 September 2007, thus they may well have originated elsewhere. They appeared only slightly worn, except for damaged wing tips on one of the Oak Hammock Marsh individuals.

Discussion

A warming climate may dramatically affect the distribution of many organisms, including butterflies.[2, 6, 13] For an emigratory insect such as the Buckeye, one might expect more northerly overwintering, emigration, and breeding to occur. At the northern edge of the range, earlier arrival dates, more frequent occurrence of late broods, and longer survival into the fall months would also be predicted. Our recent observations of Buckeye butterflies in Manitoba are consistent with these expectations. The 2001 records along the Rice River Road (see Table 1) were about 200 km north of the 1976 colony in Sandilands Provincial Forest.[7] The records compiled in Table 1 expand the flight period to 29 June – 3 October, with a strong possibility of some arrivals as early as May. A cluster of Manitoba records from the 1930s to 1941, however, suggests a possible periodic pattern, perhaps linked to episodes of drought in the Great Plains states and provinces.

Occurrence of Buckeyes at their northern range limit is known to be sporadic. For example, at Ottawa, Ontario one specimen was collected in 1966 and one individual was seen in 1996, but a "major invasion" occurred in 1981. Three temporary breeding colonies were formed, and the species was observed for several months at an old gravel quarry where two of the preferred larval food plants, gerardia and toadflax, were abundant.[8]

We hope this article will encourage other naturalists to look for this attractive butterfly in Manitoba and neighbouring regions, and to document any further extensions of its range and flight periods.

Acknowledgements

We thank R. Mooi for access to Buckeye specimens at The Manitoba Museum, Winnipeg, including the 1994 Winnipeg specimen, and L. Klassen for information on his sightings in 2007.

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"In the passage from day to night there is to me always something mysterious. In the forest that hour is mournful and sad. Around reigns an oppressive silence. Then the ear just catches some barely audible sound, as though distant sigh. Whence does it come? It seems as though the taiga itself is sighing." V. K. Arseniev, *Dersu the Trapper*, p. 125.

WEST NILE VIRUS IN WILD BIRDS IN SASKATCHEWAN: SUMMARY OF AN OUTBREAK YEAR AND POTENTIAL IMPACTS ON BIRDS

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Introduction

Most North Americans are familiar with West Nile Virus (WNV), its recent introduction into North America, and the serious disease that it can cause in people. This virus is transmitted primarily by infected mosquitoes, and in temperate climates like Saskatchewan, this occurs in summer and fall when mosquitoes are active.[4] Although human infections receive much attention, the primary hosts are wild birds, and human cases follow WNV cycles in these wild species (Figure 1). To better understand the activity and distribution of WNV in Canada, the Canadian Cooperative Wildlife Health Centre (CCWHC) has been working with governmental agencies to track WNV in wild birds since 2000.[2]

The virus first was detected in Saskatchewan in 2002, and in 2003,

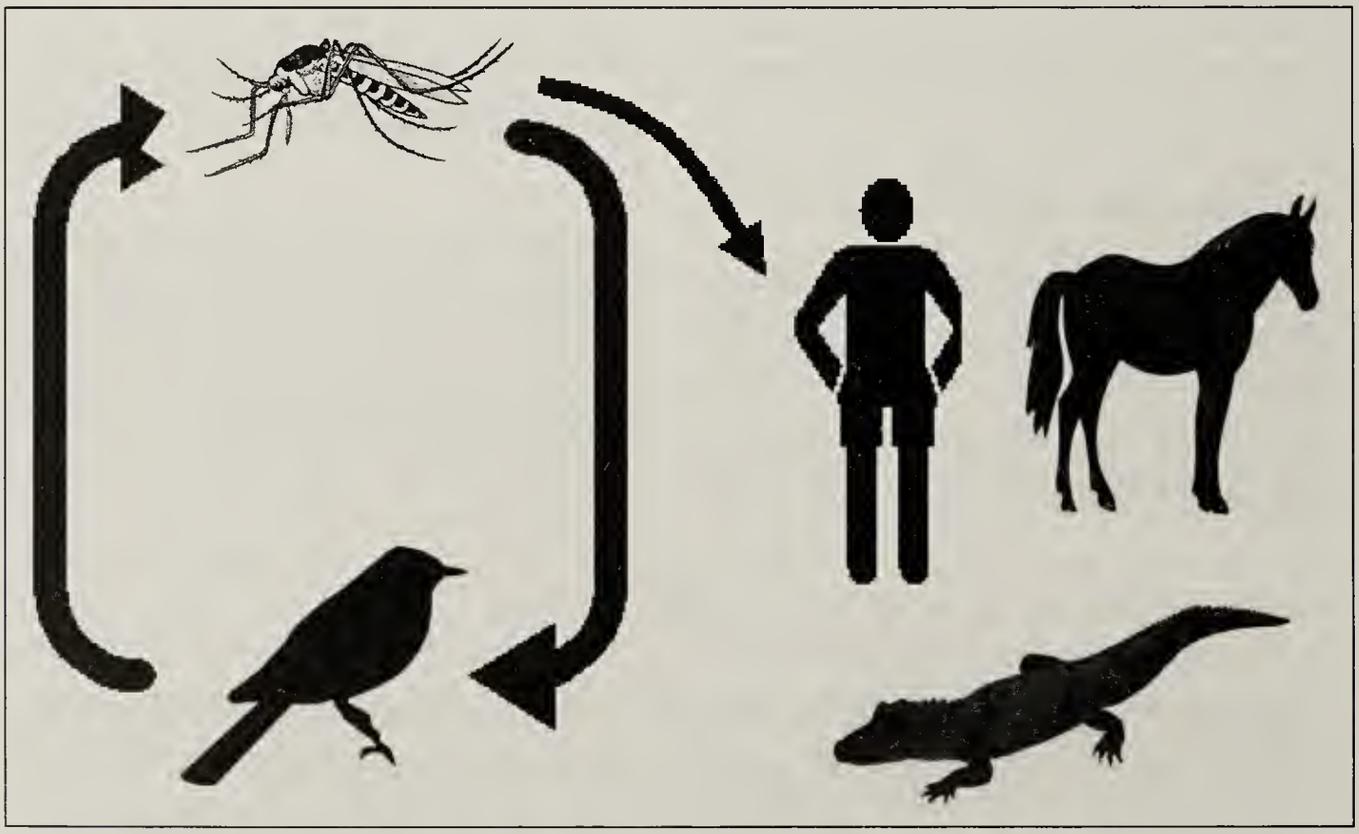

Figure 1. The West Nile Virus life-cycle. The virus circulates between birds and mosquitoes. Occasionally, mosquitoes infect humans, other mammals and reptiles.

large numbers of infections were seen in both wild birds and humans in the province. The following years saw little WNV activity. Then, in 2007, Saskatchewan held the dubious honour of having the highest number of human cases (1,422) of WNV reported in Canada for that season.[10] In 2007, numerous wild birds in Saskatchewan also were infected with WNV. This article provides a summary of WNV in wild birds of Saskatchewan during this outbreak year, and discusses the impacts of this virus on wild birds.

West Nile Virus detection in wild birds

From June through October, 2007, 390 dead wild birds from Saskatchewan were submitted to the CCWHC in Saskatoon to determine cause of death. All members of the corvid (crow) family, and any additional species with microscopic findings that might suggest a WNV infection, were tested for the presence of WNV. Diagnosis was made using anti-WNV antibodies to detect virus in the oral cavity (VecTest enzyme linked immunosorbent assay) or in tissues (immunohistochemistry), and/or by using genetic techniques (polymerase chain reaction) to detect virus in tissues.

WNV was detected in 111 of these birds (see Table 1). Infected birds represented 15 different species, and the majority were corvids (n = 72) and birds of prey (n = 30). Waterbirds, an upland game bird and a songbird also were represented (n = 9). The first bird of the season detected with WNV was an American Crow that died on July 3, 2007 and the last was a Red-tailed Hawk found on October 30, 2007.

How WNV affects wild birds

Bird species vary both in their susceptibility to infection by WNV, and in the degree of illness that infection causes. For example, corvids are extremely susceptible and mortality rates are high. Death rates of infected crows have ranged from 40-68% in the wild,[1,12] and up to 100% in laboratory studies.[6] This was consistent with findings in Saskatchewan where 72 of the 111 dead birds documented with infection were corvids. Birds of prey also are highly susceptible, and 20 of 25 (80%) Merlins found dead in the summer and fall of 2007 in Saskatchewan died from WNV. Other species such as Rock Pigeons can become infected, but any resulting disease is mild.[6] The impact of WNV on these birds is less clear. These birds still must mount an immune response to combat the infection. This requires energy, and this energy may be diverted from other activities such as growth and reproduction. Effects such as these are subtle, and require years of close monitoring of populations to be detected.

WNV infection can have other consequences on the health of birds. Infection may predispose birds to other injuries or disease. Many birds infected with WNV in Saskatchewan in 2007 also had other, concurrent, problems. For example, twelve birds diagnosed with WNV had injuries acquired just before death (e.g. bruises, bone fractures and ruptured internal organs). WNV targets many organs, and one of the common targets is the brain. Even if infection itself does not kill the bird, it may alter the bird's behaviour and lead to accidents or predation. Nine other infected birds concurrently had significant parasitic or fungal infections. Large numbers of parasites or fungal infections often are seen in debilitated animals. In these cases, WNV infection may not have been fatal on its own, but coupled with other infections, the birds' defenses likely were overwhelmed.

Table 1. Species of wild birds from Saskatchewan with detectable West Nile Virus in 2007.

Common name	Number of dead birds submitted from June through October, 2007	Number of birds positive for West Nile Virus	Proportion of birds positive for West Nile Virus
American Crow	86	60	69.8%
American Robin	22	1	4.5%
American White Pelican	30	3	10%
Black-billed Magpie	18	12	66.7%
Great Horned Owl	13	3	23.1%
Hawk (Buteo sp.)[a]	1	1	100%
Lesser Scaup	6	3[b]	50%
Merlin	25	20	80%
Northern Goshawk	2	2	100%
Northern Harrier	1	1	100%
Pied-billed Grebe	1	1	100%
Prairie Falcon	2	1	50%
Red-tailed Hawk	7	1	14.3%
Ruffed Grouse	1	1	100%
Sharp-shinned Hawk	1	1	100%
Total	240	111	46.3%

[a]This bird had not fledged and was not identified to species.
[b]These three scaup were captive and held in outdoor pens

Finally, 27 infected birds were in poor to emaciated body condition. They may have been battling infection for some time, and were too ill to feed themselves properly. Alternately, if they were already in poor nutritional condition, they may have been more vulnerable to developing serious disease following infection.

It is clear from Table 1 that a wide range of bird species representing different families are susceptible to WNV. To date, at least 317 species of bird are known to be susceptible.[3] This means that although WNV has caused or contributed to death in at least 15 different bird species from Saskatchewan, it has the potential to infect many more. Our method of WNV detection relies on carcasses, and favours species that suffer serious illness and die. In addition, the numbers presented here are based solely on dead birds found by the public and submitted for examination rather than on systematic research into WNV infection rates in wild birds. For this reason, 111 birds represents a gross underestimate of the actual number of birds that succumbed to infection in 2007. Theophilides et al. showed that the number of dead birds brought to laboratories such as the CCWHC is dependent on the number of people who report and submit them, rather than on the actual number of birds that died in the area.[11] Much of Saskatchewan is rural and sparsely populated, and presumably many carcasses never are found. Visible species that live around human settlements like crows and magpies, and large birds such as birds of prey, tend to be detected and submitted in higher numbers than rural- or forest-dwelling or smaller species. Carcasses that are not picked up, soon disappear because the ecosystem is very efficient at recycling organic matter.

Hot summer temperatures, predators and scavengers result in rapid assimilation of carcasses into the environment before they are found.

Effects on bird populations

Impacts of WNV infection on individual birds can be dramatic (e.g. death), but impacts on wild bird populations are more difficult to assess and require estimates of population sizes. Although population data for most wild bird species are limited, Breeding Bird Surveys (BBS) and Christmas Bird Counts that have been conducted in North America offer some measure of population change over time. Using data collected from North American BBSs, La Deau et al. demonstrated continent-wide declines in seven bird species after the introduction of WNV in 1999.[7] Six of these species (American Crow, Blue Jay, American Robin, Eastern Bluebird, Black-capped Chickadees and House Wren) are found in Saskatchewan. La Deau et al. also found striking regional declines for many bird species, particularly in eastern North America where WNV was first introduced and has been present for the longest period of time.[7] These authors predict that, in a few years, more dramatic declines in bird populations may become evident in the west.

The Canadian Wildlife Service has published BBS data, by province, up to 2006.[5] Of all of the species diagnosed with WNV in Saskatchewan in 2007, there has been a slight downward trend in abundance of crows and magpies from 2002 – 2006. Statistical analysis by decade showed that the decline in American Crows in Saskatchewan is significant, but it has been occurring since the 1970s, long before WNV was first detected in 2002. Crow populations were in decline at the time of WNV arrival in Saskatchewan, and WNV may have contributed to further decline, but this cannot be distinguished from the decline already in progress. BBS data from 2008 in Saskatchewan will be valuable in helping to detect any population effects of WNV following the outbreak in 2007.

Through its impact on bird populations, WNV also has the potential to alter ecosystem dynamics. Crows and magpies readily feed on carrion, which makes them important scavengers. In addition to removing rotting carcasses from the environment, crows and magpies are resistant to many bacteria and viruses that are potentially infectious for other species. By consuming dead animals, they decrease the persistence of potentially infectious or toxic material in the ecosystem. In the absence of crows and magpies, other scavenger species may proliferate. This could result in unpredictable new conflicts and management challenges, such as was seen in the Indian subcontinent following the decline of vultures and subsequent proliferation of feral dogs.[9]

Finally, WNV is a potential threat to certain threatened and endangered bird species, such as Greater Sage-Grouse populations in Saskatchewan. Although no Greater Sage-Grouse were submitted to the CCWHC in 2007, WNV was detected in Greater Sage-Grouse found dead in Alberta in 2003. Naugle et al. followed adult female sage-grouse in Alberta, Montana and Wyoming and documented a 25% decrease in survival during the WNV season in 2003.[8] WNV therefore appears to be a real and additional threat to this endangered population.

Summary

The impacts of WNV on wild birds in Saskatchewan are varied and still poorly understood. WNV now is an

established and, probably, permanent virus on the Canadian prairies. As the virus continues to cycle in wild birds in the province, it will be important to monitor bird populations in order to detect any impact on birds of Saskatchewan. Examination of sick and dead birds is one way to track the virus, but this method depends entirely upon the participation of people who find dead birds and send them to laboratories where cause of death can be determined. As summer approaches, residents of Saskatchewan can help track WNV by reporting and collecting dead birds. CCWHC welcomes all submissions of dead wildlife (fish, amphibians, reptiles, birds and mammals) as part of its disease surveillance program. Because WNV can infect humans, all carcasses should be handled with appropriate safety precautions. Please contact CCWHC for detailed instructions.[2] Briefly, dead animals should not be touched with bare hands. Disposable or rubber gloves should be worn, or a sturdy plastic bag can be turned inside-out and used as a glove to pick up the carcass. Dead animals should be placed in two plastic bags, keeping the outer bag uncontaminated. Contaminated gloves can be removed and enclosed within the outer bag to facilitate appropriate disposal at the laboratory. If you are uncomfortable handling dead animals or have any questions, please contact the nearest Saskatchewan Environment office to report any carcasses, or contact the CCWHC regional centre in Saskatoon for more information.[2]

Acknowledgements

The author thanks the editors for their helpful comments on the manuscript.

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BIRD BEHAVIOR: NORTHERN GOSHAWK, COMMON RAVEN AND AMERICAN CROW

Northern Goshawk

Our house backs onto a wild ravine in west Calgary and for a number of years I have been providing cracked corn for pheasants. This winter, the pheasant flock was as large as 22 on several days. In late January (2008), an immature Northern Goshawk showed up and regularly hunted the pheasants, being successful a couple of times each week. Mostly it perched on deck rails, fences, and sometimes willows waiting an air-borne opportunity to strike the pheasants. On two or three occasions, I observed the goshawk fly to the ground and attempt to ambush (confuse?) the pheasants by running, Velociraptor-like, after them through the willows. I did not see it making a kill through this technique.

Common Raven

In the late 1990s, we were having lunch on a bank of the Bow River at Bow Valley Provincial Park. We noticed 4 or 5 adult Canada Geese in the water surrounding a single gosling. I wondered why there was not a larger number of chicks and quickly observed a possible answer. A Common Raven glided in and circled above the geese, which moved to deeper water. The raven attempted a couple of times to get the chick but a dominant goose deftly pushed the gosling underwater at key times to avert danger. At an opportune moment, the raven dived in, grabbing the chick with its beak. It flew up and over to a nearby gravel bar, landing to kill and eat parts of the chick. The adult geese watched helplessly.

American Crow

In 1954/55 I had a pet American Crow in Young, Saskatchewan. At night, it roosted in the storeroom at the back of my parents' drug store. In late afternoon, as the store was closing, my mom or dad would call the crow's name (originally 'Jake' but shifted to 'Jick') and it would fly into the front of the store, search until it found a pencil, and then fly directly to the store room. In the morning, there would be a groove pecked the length of the pencil and all the graphite would be gone. On the few occasions when Jick could not find a pencil, it settled for a (then 5¢!) chocolate bar. As a matter of interest, Jick stayed with us through the winter and unfortunately was shot the second year by someone who did not like the way it befriended kids by swooping in to steal a toque. Of course, I do not condone capturing/adopting pets from the wild, but if a youngster brings home a newborn, what else could a parent do but provide life support?

- *Ken Scott*, Email: <ken@glisten.biz>

BOREAL OWL AT DEWBERRY, AB

According to the Lone Pine Field Guide, *Birds of Alberta*, "The Boreal Owl ranks in the top five of the most-desired species to see." This guide also says that Alberta is one of the best places in the world to encounter this pint-sized owl.

I took this picture early in the morning on March 4, 2008, outside my home in Dewberry, north of Lloydminster. The owl was on the branch at seven a.m. when I first saw it and was still there at ten a.m. when I left. We did look for the owl over the next few days but we are surrounded by heavy bush and there was still lots of snow on the ground, and we did not see it. Apparently they are very approachable.

My wife and I felt quite honoured with this very tame and beautiful owl. As we do have a mixedwood and conifer woodland, we have hopes that it may stay and nest. The nest is usually placed in an old woodpecker hole or other tree cavity.

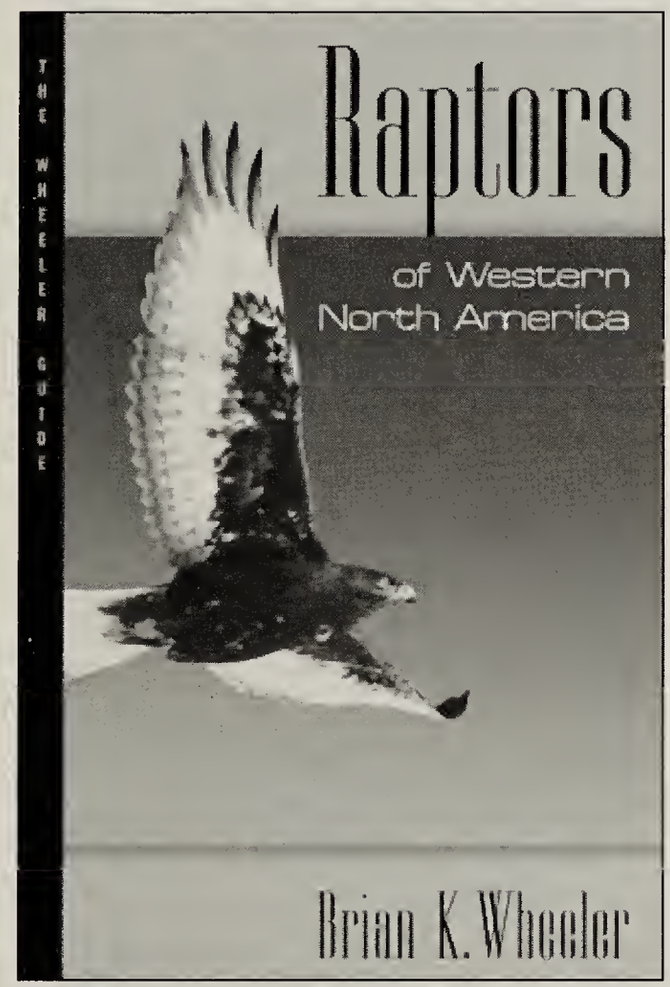
- *Maurice Clarke*, Box 143 Dewberry, AB, T0B 1G0.

Boreal Owl at Dewberry, AB on March 4, 2008. *Maurice Clarke*

NATURE LIBRARY

RAPTORS OF WESTERN NORTH AMERICA

WHEELER, BRIAN K. 2007. Princeton University Press, Princeton, NJ. 15 cm by 23 cm. Soft Cover. 560 pages. 622 colour plates. 56 maps. $29.95 US. ISBN: 978-0-691-13477-2.



This book is the definitive photographic guide to the 33 diurnal raptor species of western North America: vultures, hawks, eagles and falcons. There is a companion volume for eastern North America entitled *Raptors of Eastern North America* also by Brian Wheeler. For people in western Canada, the western edition will more than suffice. The volume's geographic coverage is the continental US west of the Mississippi River as well as Alaska, western Canada, Yukon, Northwest Territories, western Nunavut and northern Mexico. Seventeen of the 33 profiled species occur in western Canada, the other 16 featured raptor species occur only in the southwestern US and northern Mexico.

Readers should carefully review the introduction, which clearly describes the structure and organization of the 33 species accounts that make up most of the book. Each species account begins with sections on ages (age cohorts), subspecies, colour morphs, size, species traits, subspecies traits, adult traits, subadult and juvenile traits and abnormal plumages. These sections are further subdivided by body region: head, body, wings and tail. Key external features are written in bold in the text. These descriptions are detailed and presumes the reader has previous knowledge of the species' basic identifying features.

The latter half of each species account has sections related to habits (behaviour), habitat, feeding and prey, flight, voice, status and distribution, nesting and courtship, conservation (including threats), similar species, abbreviated references and range map(s). Each species account ends with a series of superb colour plates and captions. Information in the colour plate captions is bulleted and highlights the key identifying features in the colour plate.

Unfortunately, the colour plates do not directly correspond to descriptions of

ages, subspecies and colour morphs in the species accounts. The descriptions of behaviour, biology, conservation and threats contain current information and are very readable. The conservation sections are particularly useful in discussing habitat loss, pesticides and efforts to conserve raptor species.

The range maps are based on the most up-to-date information available and use the detailed research/regional approach found in the *A Field Guide to the Warblers of North America* by Dunn and Garrett (1997). Largely, the range maps are accurate, clear and sharp though omissions do occur; for example, the Merlin range map does not show that Merlins breed and winter in the rural and urban areas in the southern Prairies.

Before the species accounts there is a series of glossaries of general terms; anatomy and feathers; plumage, molt and age; perching flying displays; and perching and flying attitudes. The terms in each glossary are subdivided into logical sections, which makes it easier to find the needed definition. For the perching and flying attitudes glossary, there are colour plates directly linked with the term definitions. Definitions are clear and concise, and all key ornithological terms are included. These glossaries might become your avian 'dictionary' of choice. Following the glossaries, there is a brief section on the photography methods and equipment used to create the colour plates.

The reference section of this book is an excellent gateway to the raptor literature for western North America. There are over 300 publications cited in this volume. These are peer-reviewed articles, conference papers, book chapters, monographs and government reports. Each species account can have from 12 to over 80 references, depending on the species.

I highly recommend this guide to anyone seriously interested in the identification of diurnal raptors of western North America.

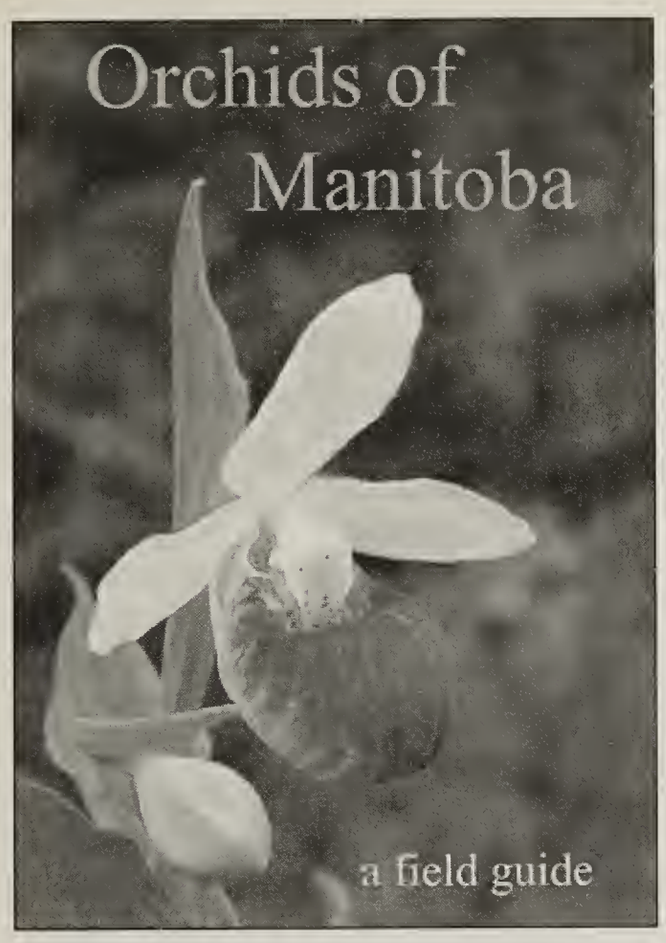
Reviewed by Rob Warnock, 3603 White Bay, Regina, SK S4S 7C9, Email: <warnockr@accesscomm.ca>

ORCHIDS OF MANITOBA: A FIELD GUIDE

DORIS AMES, PEGGY BAINARD ACHESON, LORNE HESHKA, BOB JOYCE, JOHN NEUFLED, RICHARD REEVES, EUGENE REIMER and IAN WARD. 2005.Native Orchid Conservation Inc., Winnipeg, MB. 159 pages. Soft cover. 21.5 cm x 14 cm. Colour photographs throughout. ISBN 0-9734864-0-6. $17.95 CAN.

Manitoba is well known (and sometimes disparaged) for its wetlands, fens and bogs but it is the presence of these features that have made it such good habitat for some of the most beautiful flowers in the world: orchids. Manitoba has the greatest orchid diversity in the prairie provinces with 36 species, including two that are protected under the national *Species at Risk Act*: the Western Prairie Fringed-orchid (*Platanthera praeclara*) and Small White Lady's-slipper (*Cypripedium candidum*).

Orchids of Manitoba is a field guide prepared by the Native Orchid Conservation Inc. (NOCI) to help amateur naturalists and other plant enthusiasts identify and learn more



about wild orchids. NOCI, a non-profit organization based in Manitoba, was founded in 1998 to "protect mini-ecosystems and their plant communities" (p. 8). The enthusiasm of NOCI for orchids is evident in the book, which is full of spectacular colour photographs taken by NOCI members and represents a considerable amount of field work. The introduction contains an impassioned plea for orchid conservation by all levels of government as well as individuals. The back page reminds all orchid lovers not to unduly disturb these flowers while viewing or photographing them, and to report all observations of rare orchids to the Conservation Data Centre.

The field guide includes brief but well-illustrated chapters covering orchid history, biology, habitat, conservation, and protection of species and ecosystems. The section on orchid biology includes a labeled photograph of an orchid flower and a close-up of the column, which aids in the identification of species. A chart of flowering times shows at a glance when the different species are in bloom. The taxonomic key to both genera and species is easy to use but is not generally necessary as most species can be identified by the wonderful colour photographs. A glossary is located near the end of the book in case you encounter unfamiliar terms.

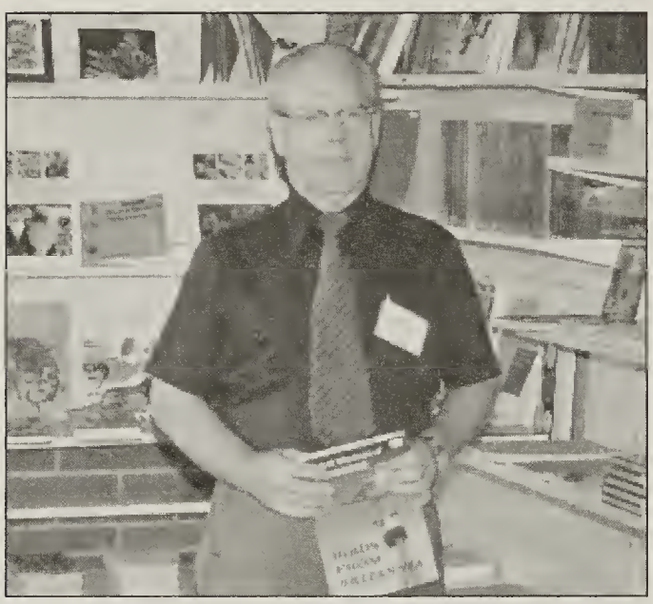
The species accounts, organized alphabetically by the Latin name, are thorough. Two pages are devoted to each species and include a range map, character descriptions and at least three photographs. Close-up shots of the flowers, fruit and/or leaves are commonly included. The character descriptions contain information about the overall height of the plant, leaf shape and texture, and colour and appearance of the flowers. A special section called "aids to identification" notes which species are similar and how to best tell them apart. The relative abundance and habitat of each species is noted as well as the etymology of the Latin names. Information about the ecology of the species as well as the main pollinating organisms are included. According to the guide, orchids in Manitoba are pollinated by a diverse range of insects including nocturnal moths, parasitic wasps, bumblebees, small Halictid bees, Syrphid flies and yes, even mosquitoes. One species is actually pollinated by rain!

Most of the orchids in Saskatchewan, Alberta, Minnesota and the Dakotas are covered in this publication, making it useful for orchid lovers outside the province of Manitoba as well. The photographs alone make this an outstanding book, and anyone who has ever trekked through a bog to see a rare orchid will find this book a useful addition to his or her library.

Reviewed by Diana Bizecki Robson, The Manitoba Museum, Winnipeg, MB, R3B 0N2

IN MEMORIAM: FRANK HENRY BRAZIER (1913 - 2004)

MARY I. HOUSTON, 863 University Drive, Saskatoon SK, S7N 0J8, and ROBERT W. NERO, 546 Coventry Road, Winnipeg, MB, R3R 1B6.



Little is known about Frank's early years. He was born at Macrorie, SK on July 25, 1913 and took his schooling in Moose Jaw. After serving overseas with the Canadian Army in World War II, he started work with the Department of Mineral Resources in Regina and lived there for the rest of his life.

He served as president of the Regina Natural History Society from 1954 to1956. He began service to the Saskatchewan Natural History Society (SNHS) as chair of the conservation committee in 1956 and immediately after stepping down from the Regina presidency he was elected president of the provincial society. During his year of SNHS presidency, 1956-1957, he called more executive meetings (seven) than any predecessor and helped manage an extremely successful spring meeting in the Cypress Hills. He orchestrated the first successful application to any granting agency; the society received $1,100 from the Department of Natural Resources to produce a larger *Blue Jay* on better quality paper. A generous and admiring Californian, C.M. Goethe, took out twenty 5-year subscriptions to the *Blue Jay*, one for each University in California, and a 10-year subscription for himself. That year, the society printed 5,000 membership pamphlets, 2000 to be distributed by the Saskatchewan Museum of Natural History in its new building, and the rest were distributed widely to previous subscribers, doctors, nature columnists, school unit chairmen and secretaries, school superintendents, officers of the School Trustees Association, Ducks Unlimited "kee-men" and Boy Scout leaders. The result was the largest increase in membership – 600 new members. By 1960, the society had reached an all-time high of 2925 paid-up members.

In September 1962, Frank became treasurer of SNHS. It was during this period that he initiated a new venture, a bookshop by mail, the Blue Jay Bookshop. He printed a list of books for sale in the February 1964 *Newsletter* and mailed out the books as they were ordered. In later years, he circulated a catalogue of books for sale (up to 18 pages of small print) along with issues of the *Newsletter*. Members of the society obtained a 10% discount, and Frank would order any book in print on any subject.

The bookshop showed a profit of $322 from book sales in its first full year of operation, increasing to a profit of $679 in 1965, $1290 in 1967 and $1534 in 1968. As sales increased, the executive realized that Frank should give up his other duties to devote his time to the Blue Jay Bookshop, beginning with the annual meeting in September 1968.

He also took books to meetings where he sold them directly. In 1975, he was invited to take the entire bookshop to the American Ornithologists' Union meeting held in Winnipeg. In 1987, Frank's last year as bookstore manager, there was a record profit of $5284 from total sales of $35,013. In that year, Frank had taken the bookshop to the SNHS annual meeting, to local society meetings in Regina, Moose Jaw and Saskatoon, to the joint Canadian Nature Federation/SNHS meeting in Saskatoon, a BIOSCAN meeting in Saskatoon and to the Whooping Crane Conservation Association's annual meeting in Regina. Frank handled all this with unusual devotion and exceptional efficiency, as he had done for 19 years. He also stocked books for the three years at the Canadian Wildlife Interpretive Centre beside Highway 1 at Webb. Not only was the bookshop a financial success but the educational impact made by the bookshop was considerable. At the end of 1987, Carol Bjorklund suceeded Frank as bookstore manager.

The prestigious Conservation Award of the SNHS was presented to Frank in 1969 in recognition of his long service to the Society in various offices, and his enterprising and creative management of the bookshop. In 1987 a new class of honorary members, known as Fellows, was created. Appropriately, Frank was among the first four awardees. At the same time, he was named Honorary President of the Society for a five-year term. Frank went the "second mile" in service to the naturalist community and he was generous with both time and money.

On occasion he gave back part of his honourarium (25% of the bookstore profits) to the Society and in June 1983, he donated sufficient money to cover the cost of a colour front cover of the *Blue Jay*: an outstanding photograph of a Swamp Pink, *Arethusa bulbosa*, taken by his close friend and birding companion, Elmer Fox.

For years, Frank summarized Regina bird records for each season for the regional editor of *Audubon Field Notes*. He also contributed 52 items to *Blue Jay*, including six book reviews and notes on a cougar and an unusual mushroom in Regina, and edited three issues of the *Newsletter* when the incumbent editor, Doug Wade, took up a new position at the Northern Illinois University.

A keen birder with a flair for differences in plumage or behavior that might signal the presence of an unexpected species, Frank took delight in sharing his observations of unusual species, including the first confirmed Saskatchewan records of the Ruff (May 8, 1965); Black-throated Gray Warbler (May 3, 1965); and Blue-winged Warbler (November 9, 1965). The first provincial sighting of the Yellow-crowned Night Heron (20 May 1978, with Callin and Chaskavich) was near Lebret. The Yellow-billed Cuckoo sighted on July 6, 1987 was also seen by Bob Kreba.

His firsts for the Regina area were the Chimney Swift (May 14, 1958, with E.L. Fox); Caspian Tern (July 22-23, 1960, with E.L. Fox); and Harlequin Duck (September 6, 1958). With Elmer Fox and Fred Lahrman, Frank reported Regina's first breeding records of the

Western Grebe and Forster's Tern (June 18, 1960), and Yellow-rumped Warbler (July 8-12,1965).

He also had a number of hypothetical first records. Probably reliable firsts for Regina were Kentucky Warbler (heard only, on July 14, 1989); Ivory Gull (September 4, 1989); Laughing Gull (May 19 & 26, 1959), and for the province were Least Tern (May 26, 1957); Golden-winged Warbler (May 18, 1962) and Lesser Black-backed Gull (May 28, 1977).

Several times each year, Frank and his wife, Marjie, would go to the Qu'Appelle Valley, anywhere from Fort Qu'Appelle to beyond Broadview, for a day of intensive birding with Frank's close friend, Manley Callin. Their close ties are evident in Frank's memorial to Callin (*Blue Jay* 44:66-69, June 1986).

When his beloved Marjie died on November 13, 1990, Frank was bereft. For an intimate glimpse of this man, see the photograph and in memoriam, "Rosy Finch in Regina – Marjie's last bird" (*Blue Jay* 49:40-41, March 1991). Although he continued his daily walks around Wascana Lake for several years after his wife's death, he gradually lost interest in life. He died in the Wascana Rehabilitation Centre at 91 years of age, on September 6, 2004. Frank was one of the most innovative, dedicated and industrious members of the Society since its inception in 1949.

Barn Swallow gathering mud for nest *Randy McCulloch*

MYSTERY PHOTO

JUNE 2008 MYSTERY PHOTO

This little bird was found 'jammed' into a tree hole at dusk on May 6 and was still there at 10:30 p.m. when this picture was taken. It was gone at 6:05 a.m. the next morning. What kind of bird is it and what is it doing?

ANSWER TO THE MARCH 2008 MYSTERY PHOTO

How did the beavers chew the trunk of a tree at a height of about 6 feet above the ground? One reader suggested that the higher chewing was made when the water level was high, and the lower cuts when it was low. Lucille Bradatsch who took the photographs went back to the scene of the chewing three weeks later and took the photograph shown above. Based on the position of the tree at that time, Lucille wrote, "Though I don't know much about the habits of beavers, I can imagine the following scenario. The trunk of the tree seemed very healthy and likely had a heavy crown with weighty branches. The beavers chewed at the base until the weight of the crown, possibly aided by a gust of wind, caused it to lean and to fall. The beavers then chewed on the trunk as it lay on the ground and one cut off the top before the base of the tree was cut through.Relieved of the weight, the trunk righted itself and was ignored until the beavers disposed of the severed branches. Later they returned and cleaned up the site. Only the old stumps and the new one remained the last time I checked."

The editors would like to thank Lucille for providing the beaver chewing photos and story.

Blue Jay, founded in 1942 by Isabel M. Priestly, is a journal of natural history and conservation for Saskatchewan and adjacent regions. It is published quarterly by **Nature Saskatchewan, 206-1860 Lorne Street, Regina, Saskatchewan S4P 2L7.**

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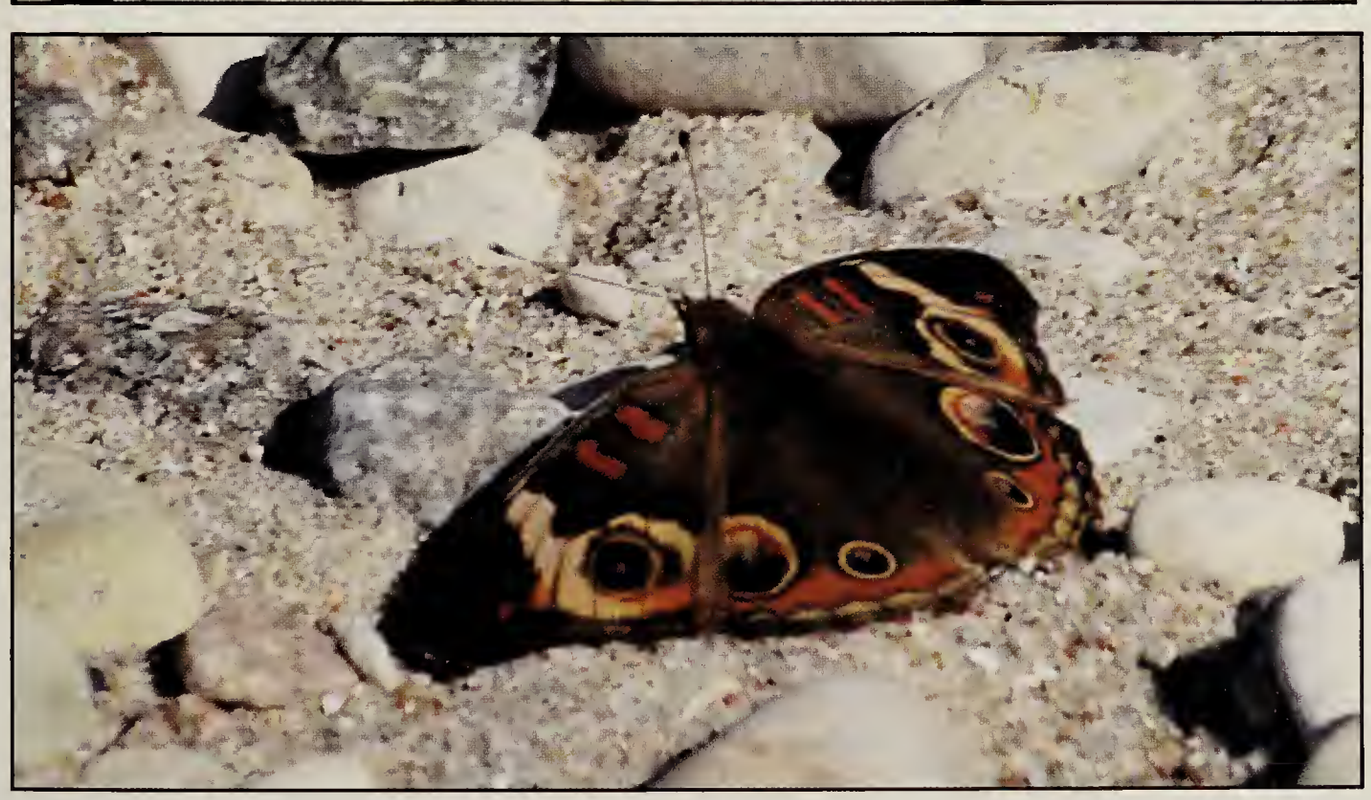

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